

BROOKLYN BOTANIC GARDEN

PLANTS
&
GARDENS

BROOKLYN BOTANIC GARDEN RECORD

PLANTS & GARDENS

FLOWERING TREES

SPRING
1963

Crab Apples
Dogwoods
Magnolias
Cherries
and
Less Familiar
Kinds

How to Select
and Grow Them
for Prolonged
Garden Beauty

NEW SERIES

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NO. 1



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Genereux

Flowering crab (*Malus arnoldiana*): pink-tinted white flowers surround every branch.

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Spring 1963

Only a select group of trees—those which bear more or less conspicuous flowers, are included in this Handbook. Hence the title **FLOWERING TREES**. But curiously enough, this designation embraces certain undramatic but individually no less beautiful trees such as the catkin-bearing willows, oaks and alders.

While spring is the great blossom time in temperate climates, there are species in the tropics which bloom more or less continuously throughout the year. Continuous "overhead" bloom in temperate climates can be achieved from early spring well into autumn only by selecting different species. The charts on pages 72 and 75 will help on this.

The tree with the longest blossoming period? For Florida, southern California and other warm areas, we do not have the answer at hand, but in our New York region it is the hardy silk-tree (*Albizia julibrissin rosea*)—see page 28. Here at the Botanic Garden some of our silk-trees bloom for two full months during the summer, with fresh flowers daily. The species is somewhat exotic in appearance and a more or less sprawly grower, but selective pruning will control its shape. Unusually cold winter seasons kill the silk-tree cambium at intersections of branches (a few of the smaller branches too), but the trees continue to bloom vigorously, year after year. It is a "Rembrandt" among the trees, and at least one specimen should be in every garden where the climate is no more severe than that of New York City.

Another summer-blooming tree worthy of special mention is *Sophora japonica*, sometimes called the Chinese scholar-tree, or Japanese pagoda-tree. The shape of older specimens closely resembles that of the American elm and the white wisteria-like flowers in mid-summer are an added attraction. *Sophora japonica* makes a splendid substitute for the fine old elms in areas where the Dutch elm disease is killing them. It is another "Rembrandt" among the trees.

The Japanese dogwood (*Cornus kousa*), which goes by the name of "kousa" in its native land, ranks high among flowering trees of early summer. It is neat in form and its branches are well clothed with dark green foliage. It blooms several weeks after the native eastern flowering dogwood (*Cornus florida*). Warm reds in the autumn foliage and in the fleshy fruits add to the good qualities of this sturdy tree.

It is a special privilege to pay tribute to Guest Editor Harold Perkins, and at the same time to thank him and the many authors who collaborated on this Handbook. May their collective effort lead many readers not only to discover—but to better evaluate flowering trees for their own home plantings.

The Botanic Garden's Handbook on **THE HUNDRED FINEST TREES AND SHRUBS** will be a helpful companion to this volume.

Sincerely,



Director



McFarland

Malus halliana, a double-flowering crab apple with bright pink blossoms.

CRAB APPLES

*Choose trees for profuse bloom, colorful fruits
and interesting branching habit*

L. C. Chadwick

FEW kinds of small trees, if any, can match the over-all excellence of the flowering crab apples. There is a size, growth habit, type, and color of flower and fruit for nearly every landscape requirement. Quality is an elusive thing, especially in woody ornamental plants, but good quality should include, besides excellent flower and fruit, hardiness, durability, adaptability, interesting branching habit, and foliage that is pleasing in color and texture. Coupled with these characteristics would be low maintenance and freedom from pests. Few small trees can compare with the flowering crab apples in meeting these requirements.

As contrasted with true apples, the crabs are usually considered to include species, varieties or clones that have fruits

two inches or less in diameter. It is not easy to distinguish between the ornamental sorts and the so-called economic crab apples. Since both contain many kinds that satisfy the demands of quality, they will be considered together here, without discrimination.

Most of the crab apples are self sterile but they hybridize so freely that many seedling variations are produced. Reports indicate that some 600 different kinds have been introduced into the trade, though probably not more than half of these are being grown by nurseries today. Within a given geographic area, 25 or 30 types would furnish all the landscape effects desired. Because of variable hardiness, adaptability to soils and other environmental conditions, and individual prefer-

ences of growers, 75 to 80 kinds might be desirable for the whole United States.

Any attempt to select a group of the "best" of the crab apples would be somewhat presumptuous on my part since conditions vary so much over the country. Such lists have been compiled for state and regional areas but, as with all lists, they are subject to change as new and better kinds are developed and introduced. Any such list must therefore be highly flexible. It will be my endeavor to point out desirable kinds with widely differing growth habits, flowers and fruits.

The landscape use of crab apples includes plantings as specimens for home lawns or large industrial and public areas; for groups, borders, and foundations (especially for large buildings); for hedges and for street, boulevard, and highway designs. There must be considerable variation in size, shape and flower and fruit characteristics to satisfy these needs.

Trees of Different Sizes

Crab apples vary in size from 6 feet in height to those reaching 40 feet. For many years the best of the dwarf crab apples has been the Sargent crab (*Malus sargentii*). It is shrublike in habit, only 6 to 8 feet high, but may be 12 or more feet across, dense and stiffly branched. The foliage is glossy dark green, and sometimes gives good yellow fall color. The flowers, late in the season, are small but abundant and somewhat fragrant, pink in bud but pure white when fully open, and produced on spurs. The fruits are similarly abundant but small, $\frac{1}{3}$ inch or less in diameter, and dark red. They remain long on the plant and provide excellent winter food for birds. Besides its use as a general landscape plant and for covering banks and slopes, the Sargent crab makes a satisfactory low hedge. There is a pink-flowering variety, *Malus sargentii rosea*.



Genereux

The Sargent crab (*Malus sargentii*) is known for its abundant flowers, its small red fruits (see also page 6) and its desirably small size.



McFarland

A typical branch of the Sargent crab in autumn

There are many crab apples in other size categories. Among those reaching 12 to 15 feet are *Malus atrosanguinea*, *M. halliana parkmani* and 'Profusion.' *M. arnoldiana*, *M. floribunda*, *M. micromalus*, *M. zumi calocarpa*, 'Katherine' and 'Van Eseltine' are among the outstanding kinds ranging from 15 to 20 feet in height. In the 20- to 25-foot category are 'Crimson Brilliant,' 'Dorothea,' 'Pink Beauty,' *M. hupehensis* and many others. Among the largest forms, ranging from 25 to 30 feet and over, are *Malus baccata* and *M. purpurea*, many of their varieties and clones, and the 'Hopa' crab.

Trees of Rounded and Broad Form

Crab apples that are rounded in form abound. Among the best might be listed *M. arnoldiana*, *M. atrosanguinea*, *M. floribunda*, *M. purpurea aldenhamensis*, *M. purpurea lemoinei*, *M. zumi calocarpa* and the clones 'Bob White,' 'Dorothea,' 'Cheal's Crimson,' 'Henry F. duPont,' 'Liset,' 'White Angel,' and 'Winter Gold.' Among the outstanding broad, upright forms are *M. baccata* and its varieties *jacki* and *mandshurica*, *M. scheideckeri*,

M. spectabilis, 'Dolgo,' 'Pink Beauty,' 'Profusion,' 'Radiant,' 'Snowdrift,' 'Strathmore,' and 'Vanguard.'

Narrow, Upright Trees

Often there is need for narrow upright trees of columnar, fastigiate or pyramidal form. *Malus baccata columnaris*, *M. robusta erecta*, *M. tschonoski* and 'Beauty' are among the best in this category. *Tschonoski* is especially interesting, not because of its flowers and fruits, which are quite mediocre, but because of the foliage. The young leaves are silvery white, the felty substance wearing off the older leaves except for grayish tomentum on the underside. While crab apples are not, as a group, outstanding in fall color, *Malus tschonoski* shows a mixture of yellow, bronze, orange, crimson and purple in its autumn foliage.

This species must attain considerable age before it flowers, and even then the small white blossoms and brownish-yellow fruits are produced sparingly. The tree might be particularly useful for street planting where a narrow, upright, sparse-fruited type is desired.

Pendulous Forms

There are few pendulous forms that are really outstanding, the best being Exzellenz Thiel,' 'Oekonomierat Echtermeyer' ('Pink Weeper') and 'Red Jade.' Red Jade, with white flowers and small bright red fruits, is undoubtedly the best. It was introduced by the Brooklyn Botanic Garden. Also might be mentioned the vase-shaped form of *Malus hupehensis*. Less striking in appearance, *Malus halliana parkmanii* has been described as the most graceful of the flowering crab apples. 'Van Eseltine' is also vase-shaped. *Malus sikkimensis*, the Sikkim crab, is among the most irregular in branching habit.

Crab Apples for Streets and Highways

Recently, the crab apples have been recommended extensively for street and high-

way planting. Their use in highway designs presents few problems. In general, the choice should be limited to the more informal types, those that are thoroughly hardy, and free of serious insects and diseases. Beyond these points the choice may depend upon the flower and fruit effect desired.

Along city streets the use of crab apples should be planned carefully. Traffic interference and messiness of the fruit are problems to be kept in mind. The plants must be kept well back from street or alley intersections. Small, low-branched trees of dense canopy may be much more of a traffic hazard at street intersections than large high-branched trees. The upright branched types are better adapted to street planting than the broad, round-headed forms, unless the planting strip is unusually wide. By pruning off the lower limbs, the branches can be raised on the



Generous

'Katherine' is a favorite among flowering crabs. The double flowers may be white or pink and the small fruits are yellow.



McFarland

Malus halliana parkmani has been called one of the most graceful of the flowering crabs. The bright pink flowers are double; the small fruits are red.

upright types without destroying the looks of the plant much better than on round-headed forms. Situations have existed along city streets where low-branched trees made it impossible to walk when carrying an open umbrella. But if they had been limbed up sufficiently to prevent this difficulty, their effectiveness would have been destroyed.

The larger-fruited forms of crab apples are best avoided for street planting and for use around terraces and walks because of the messiness of the fruit. The small-fruited forms or those that fruit sparingly are better choices. While it is possible to use synthetic growth substances to prevent a large proportion of the fruits from forming, the results desired are not always obtained and the operation is somewhat expensive.

Home-owners may want a dual-pur-

pose crab apple, one with fruits large enough to be useful for preserves and jellies and also effective as an ornamental. While there are several clones that can be used in this way, my choices are 'Beauty,' 'Dolgo,' 'Hopa,' and 'Patricia.'

Disease Resistance

For the past two or three years extensive surveys have been made on the susceptibility of crab apple to serious insect and disease infestations, particularly apple scab, cedar-apple rust and fire blight. The types selected for the chart which follows are, for the most part, reported as highly resistant to the first two diseases mentioned. Less information is available on susceptibility to fire blight.

Omitted from the list is one of the most common crab apples, 'Bechtel,' because of its susceptibility to cedar-apple rust and

scab. In general, the Asiatic crab apples are much more resistant to apple scab and cedar-apple rust than the native types.

Blooming Periods

The flowering crab apples bloom over a period of about four weeks. *Malus baccata mandshurica* is the earliest, flowering in mid- to late April or about the same time as the star magnolia. Most of the others follow during the next ten days to two weeks. 'Dorothea,' 'Profusion' and *M. sargentii* generally come afterward. Among the latest to flower are 'Klehmus,' 'Prince Georges,' *M. sikkimensis*, *M. toringoides* and *M. tschonoski*.

Flower and Fruit Variations

The flowers vary greatly in petalage, from singles to doubles and from less than an inch (*M. sargentii*, *M. toringoides*) to more than two inches in size ('Katherine,' 'Prince Georges'). Colors are given in the chart on page 10.

The fruits also vary greatly in size and color (see chart). Other than for dual-purpose use, the large-fruited forms are not considered as satisfactory as those with small fruits, because of their tendency toward alternate bearing, early dropping, wormy and misshapen fruits, and messiness when fallen. Several kinds hold their fruit late into the winter. The best of the red-fruit types in this respect are *M. baccata jackii*, *M. sargentii*, *M. zumi calocarpa*, 'Radiant,' 'Red Jade,' 'Vanguard' and 'White Angel.' The best of the yellow-fruited types for holding fruit are *M. toringoides*, 'Bob White,' 'Dorothea' and 'Winter Gold.'

Cultural Requirements

Flowering crab apples are not exacting in their cultural needs. They do well in almost any fertile, well-drained soil. Propagation is by grafting, budding, or by cuttings. Budded or grafted plants should be planted a little deeper than they previously grew to avoid suckering. Deep planting, however, should be practiced only in light, well-drained soil.



McFarland

The half-inch fruits of *Malus scheideckeri* set the branches aglow in autumn with their yellow and orange tones.

After the plants are well formed, little pruning is required. Removal of suckers and occasional thinning out of the densely branched types may be required. In addition to the diseases mentioned above, scab, mites, Japanese beetle, and some leaf-eating insect may cause damage and require spraying for control. Rabbits and mice may also be a problem with small trees. The nearest Agricultural Experiment Station or Agricultural Extension Service office can give the grower the latest information on how to overcome these pests.

While there is some type of ornamental crab apple to fit nearly every landscape use, there is also room for improvement. Chance seedlings may provide desirable new forms, but a well conceived and executed plant-breeding program could go far toward producing new and superior types of ornamental crab apples.

Turn the page, for a chart describing crab apple flowers and fruits.

Flowers and Fruits of Selected Crab Apples

Plant			Flowers			Fruit
	Code	Color		Type	Color	Size
Almey*	1, 2	Bright red	S		R	2.5
Arnoldiana	1, 2	Pink to white	S		Y	1-1.5
Atrosanguinea	1	Carmine	S		RY	1.0
Baccata columnaris**	1, 2	White	S		YO to R	1.0
Baccata jacki	1, 2	White	S		BR	1.0
Baccata mandschurica	1, 2	White	S		BR	1.2
Beauty	2	White	S		BR	3.0
Bob White	2	Pink to white	S		Y to DB	1-1.5
Cheal's Crimson*	2	Pink to white	S		Y to BR	2.5
Crimson Brilliant*	1	Purplish-red	S		PR	2-2.5
Dolgo	2	White	S-SD		BR	3-3.5
Dorothea	1, 2	Crimson to rose	S		BY	1.5-2
Exzellenz Thiel	1	Pink to white	SD-D		YR	2.0
Flame	1, 2	Pink to white	S		BR	2.0
Floribunda	1	Pink and white	S		RY	1.0
Halliana parkmani	1	Bright pink	S		R	1.5
Henry F. duPont	1, 2	Pink	D		R	1.2
Hopa*	1, 2	Carmine to pink	S-SD		BR	2
Hupenhensis**	1	Pink to white	S		Y to R	1-1.5
Katherine	1	Pink to white	S		Y	1.0
Klehm	1	Deep pink	D		Greenish	2.5-3
Liset	1	Purplish-red	D		R	1.0
Patricia	2	Purplish-red	S		R	2.5
Pink Beauty	1	Pink	S		BR	2-2.5
Pink Weeper*	1	Purplish-red	S		RP	2.5
Prince Georges*	1	Pink	S			
Profusion	1	Carmine to pink			BR	1.5
Purpurea	1	Reddish-purple	S		RP	2-2.5
aldenhamensis*			S-SD			
Purpurea lemoinei	1, 2	Red-purple			RP	1.5
Radiant	1, 2	Reddish-purple	S-SD		RP	1.5
Red Jade	1, 2	White	S		BR	1.3
Robusta erecta	1	White or pinkish	S		Y & R	2.0
Sargenti	1, 2	White			R	1.0
Sargenti rosea	1	Pink	S		R	1.0
Scheideckeri*	1	Pink	S		Y to O	1.5
Sikkimensis	1	White	SD-D		GY	1.5
Snowdrift	1, 2	White	S		Y to R	1-1.5
Spectabilis albi-plena	1	White	S		Y	2-3.0
Strathmore	1	Purplish-red			P	2.0
Toringoides**	2	White	S		Y & R	1.5
Tschonoski		White	S		Brown-Y	2-2.5
Van Eseltine**	1	Carmine-pink	S		Y & R	2.0
Vanguard	1, 2	Rosy-pink			BR	1-1.5
White Angel	1, 2	White	S		BR	1-1.5
Winter Gold		White	S		Golden Y	1-1.2
Zumi calocarpa	1, 2	Pink to white	S		BR to O	1

Code

1 = Outstanding in flower

2 = Outstanding in fruit

Flower Type

S = Single

SD = Semidouble (from 6 to 9 petals)

D = Double (10 or more petals)

Fruit Color

BR = Bright Red

R = Red

G = Green

Y = Yellow

PR = Purplish-red

O = Orange

DB = Dull Brown

Size is given in centimeters; 2.5 centimeters = 1 inch.

*Somewhat susceptible to scab (Almey is highly susceptible to scab in some areas.)

**Susceptible to fire blight

FLOWERING CHERRIES

*Public displays can be a guide
for home plantings*

Bernard Harkness

Of all the flowering cherries from the Orient, the one to achieve the accolade of public recognition in the area of Rochester, New York, has been the Sargent cherry. In Durand-Eastman Park on Lake Ontario, where it was plentifully planted in the second decade of this century, the resulting display in early spring has for many people become an appointment to keep each year. This means April if spring is early, May if it is late.

Generally conceded to be the hardest and largest of the whole group, *Prunus sargentii* will reach 40 feet in height. Flowers are bright pink and are borne in pendent clusters from reddish stalks. The leaves, which are only starting to unfold at flowering time, are highly colored in bronze-red tones. In a favorable autumn there is a glorious show of orange-scarlet foliage.

Sequence of Bloom

Leaves of the European bird cherry (*Prunus padus*), which is grown in Rochester in at least three forms, unfold at the earliest opportunity in the spring. After this first spurt of activity the trees are a bit more conservative, and the chalk-white clusters of flowers (resembling choke cherry blossoms) come about a week later than the Sargent cherry. They then have the advantage of a fresh green background of full-grown leaves. This tree, too, usually causes comment and enquiry among gardeners. The abundant clusters of fruits in mid-July are much appreciated by the birds. Old trees in the Rochester area stand 30 feet high and are 30 feet across.

Also flowering about a week after



Roche

'Kwanzan,' exceptionally sturdy, is one of the more than 30 varieties blossoming in the Brooklyn Botanic Garden between mid-April and early May.

Sargent cherry is the Higan cherry (*Prunus subhirtella*). The most popular form is commonly known as Japanese weeping cherry. It can be found in most nurseries balled up for spring sales with the flowers already opening, in advance of the leaves. It is often sold when in full flower. In fact, this is a good way to buy it because there are two color forms, and it can be decided in advance which is wanted. One of them has deeper pink flowers, and is a somewhat stronger-growing tree of an eventual 25-foot height. The other has paler pink flowers; the tree is more elegant in form, erect and narrow with drooping outer branches.

Much overlooked in this group is the double-flowered weeping form known as 'Fukubana' or 'Yae-Shidare'; this variety is as hardy as the Higan cherry. It would well repay more attention from nurserymen. Areas with a longer fall season than in Rochester can enjoy the autumnal flowering of the variety 'Jugatsu,' which has an upright habit of growth.



Gantner

The Sargent cherry (*Prunus sargentii*) is first to bloom and hardiest of the group.

Next in flower succession to Higan cherry by only a few days is the Fuji cherry (*Prunus incisa*). From three plants set out in 1919 in Highland Park in Rochester there has grown a coalseed trio much wider than its 15-foot height, elegantly decked out with white flowers. Its floral effect is colored by the bright red sepals and calyx tube. The leaves are small and finely cut. Flocks of cedar waxwings keep its tiny cherries in mind in early June when such fare is scarce. E. H. Wilson brought from Japan a dwarf form under the name of 'Zansetsu.' This is the shrubby alpine plant with white petals backed by pale green sepals now called variety 'Yamadei.' It should be of interest to bonsai fanciers.

A newcomer to nursery lists is *Prunus* 'Hally Jolivette.' It is much like the Fuji cherry in effect and in its widespreading habit, and is only slightly later in time

of bloom. Nevertheless, as the product of the famed plant breeder and geneticist of the Arnold Arboretum, Dr. Karl Sax, its well-authenticated parentage involves only Higan and Yedo cherries, it being a back-cross from the hybrid to the Higan cherry.

Higan Cherries from Seed

Seedlings of the weeping Higan cherry will produce normal upright plants which can be used, if desired, as stock for grafting the pendulous varieties. Raising seedlings of any of the fruiting ornamental cherries can, in fact, be very interesting. For instance, in certain seasons early- and late-flowering cherries may bloom closer together than usual with resulting cross-fertilization. Such known hybrids as *Prunus hillieri* (*P. incisa* × *P. sargentii*), *Prunus juddi* (*P. sargentii* × *P. yedoensis*) or others could then show up accidentally among seedlings.

A Fruit-bearing Ornamental

There is one cherry among the ornamentals whose fruits owners may wish to share with the birds. It is the Manchurian cherry (*Prunus tomentosa*). As a fruit-bearer it has interested only a few people, though its subacid cherries of red or orange or white ripen early in July and are well worth having just to sample from the bush. As they are self-sterile, at least two plants are required for cross-pollination. In the event that fruiting is undesirable for any reason, the early May flowering on a single large plant is alone worth considering. There is a plant 10 by 12 feet in Highland Park, Rochester, now 70 years old; its vigor and longevity may possibly have been helped along by its never having borne fruit.

Some Species Seldom Seen

Among other species to be seen mainly in the more comprehensive plant collections, each has some desirable feature. Birchbark cherry (*Prunus serrula*) from China has glossy, mahogany-colored bark,



McFarland

The Manchurian cherry (*Prunus tomentosa*) offers fruit for equal enjoyment by man and bird.



Generous

The European bird cherry (*Prunus padus*) opens its chalk-white blossoms after the leaves unfold.

but foliage and flowers are not outstanding. Its hardiness limits are not too well established. Clove cherry (*P. apetala*) is thoroughly hardy, as it comes from northern Japanese mountains. Its botanical name, which means without petals, gives an erroneous impression, though its early flowering is rather fleeting. Nippon cherry (*P. nipponica*) is another mountain plant and its alpine habit of bushiness is its main claim to attention.

Miyama cherry (*Prunus maximowiczii*) is a moderate-sized tree with handsome autumnal coloring. Manchurian cherry (*P. maackii*), which is native Korea also, is of value mostly for golden-brown bark. It and *Prunus meyeri*, its hybrid with the Miyama cherry, had about a 40-year life span in Rochester plantings.

As trees go, the Japanese flowering cherry is an ephemeral plant. After forty years or so, plantings of Sargent cherry may be expected to need occasional replacement. References are sometimes made to collections that no longer exist. Only a few of the original plants of the E. H. Wilson introductions from Japan in 1914 now remain.

As with most plants from Japan where Japanese names are involved, considerable difficulty is expressed in keeping valid names. Even today not all of the varieties in American nurseries can be expected to check with published descriptions. There are two references, however, by which a decision as to correct name can usually be reached: the 1934 Department of Agriculture Circular 313, *The Oriental Flowering Cherries* by Paul Russell (photographs of many were published with text by Mr. Russell in *National Horticultural Magazine* from 1930 to 1934) and an English book of 1948, *Ornamental Cherries* by Collingwood Ingram.

Plants from E. H. Wilson

In 1917 the Arnold Arboretum distrib-

uted scions and plants of cultivars of the Japanese flowering cherry (*Prunus serrulata*) derived from the E. H. Wilson collections of three years earlier. Out of the 74 named varieties received at Rochester, only a few remain; nor have many been perpetuated in nurseries or in other collections. Mention should be made of those surviving the longest as a contribution towards a list of the hardiest and most vigorous among the cultivars of this species.

'Asagi' of the double greenish-yellow group has persisted, although 'Gioko' and 'Ukon' are more frequently seen. In a list compiled in 1950 by Professor G. W. Cochran of Utah State Agricultural College at Logan, detailing all collections of cherries, 'Asagi' was cited as growing in the Huntington Gardens of California.



The Japanese flowering cherry (*Prunus serrulata*) appears in many forms, among them the white-flowered variety *alba*.



McFarland

The Yoshino cherry (*Prunus yedoensis*) is a favorite in Japan, and the species which won fame in Washington, D. C. It is a hybrid between *P. serrulata* and *P. subhirtella*.

Wilson's 'Hata-zakura' and 'Ouchi-zakura' seem to be the same single white. 'Hata-zakura,' the preferred name, Ingram translates as 'Flag Cherry.' It has deep pink veining and shading at the center of the flower. Young leaves are slightly tinted bronze.

'Fudan-zakura' is an interesting plant recognized in its Japanese name as an everblooming sort. In 1945 at Rochester it was found to be the easiest and quickest of all the varieties tested for forcing out-of-season bloom. Its pale pink buds opening white come early in the season, and in less severe climates it is winter-blooming.

Fragrance is the appeal of 'Jo-nioi.' Its single white flowers are abundantly produced. 'Kunama-yama' is distinct among the pink double forms for a little central tuft of smaller petals. It has persisted in Highland Park.

'Kwanzan,' the most frequently planted flowering cherry in the United States, would be used by the Japanese, I believe, more in the background, as on a distant hill, to soften its rather harsh purplish-pink. However, one must not discount its attributes of hardiness, longevity, and general amenability to garden culture.

One of the larger trees among the flowering cherries derived from *P. serrulata* 'Shirotae' (or 'Sirotae') reflects its general acceptance as the best double white in its Rochester record. It has been noted that as a young tree it may bear single flowers. In some catalogs it may be listed as 'Mount Fuji.'

Japan's Favorite

Yoshino cherry (*Prunus yedoensis*), which is reported as the favorite in Tokyo and, in consequence, the gift of the Mayor of Tokyo for the Tidal Basin planting at Washington, D. C., is now best represented in the Rochester collections by its variety *perpendens*. However, as another weeping cherry with pink flowers at about the same time as the Higan cherry, it has small chance for great popularity.

The popular association of cherry-blossoms with Washington, D. C., is perhaps more than a coincidence as it may well be that the very best climate for long life and general success is in the area from Philadelphia to Washington. This is not to deny many handsome plantings farther north along the seaboard, especially the Brooklyn Botanic Garden display.

MAGNOLIAS

*Shortest of flowering trees
for planting in the
Temperate Zone*

Robert B. Clark

EARLY-flowering oriental magnolias are among the first trees of the season to create bold masses of color. Spectacular bloom, however, is but one of the reasons for growing these low-maintenance plants. Summer's luxuriant foliage and winter's smooth gray bark, with twigs capped by prominent, single-scaled buds, provide year-round garden satisfaction. The individual flowers are large, and are borne at tips of twigs. Pollination is largely by beetles and flies.

While flowers of the Asiatic magnolias are usually displayed on naked branches, those of the American species bloom amid the foliage between late May and mid-summer. The large leaves are smooth at the margin, usually dark green and often leathery.

Botanists regard magnolias as a primitive type of woody plant. Magnolia fossils have been identified from Lower Cretaceous rocks in which remnants of the earliest seed plants are found. In its natural distribution the genus is confined to warm temperate and tropical regions of eastern Asia and eastern parts of the Americas, including Central America and the West Indies. Individuals of certain species occur as high as 4,000 feet elevation in the southern Appalachians where soil is rich and the atmosphere continuously laden with moisture.

Magnolias flourish in gardens that afford well-drained fertile soil covered by a humus layer for moisture retention. Although they tolerate shade, they grow more vigorously in full sun. The large-flowered evergreen magnolia of the South



McFarland

Flowers of the saucer magnolia (*M. soulangeana*) may be all white or of white flushed with rose or purple, darker at the base.

is hardy only in very special sites in the North. Only the largest-leaved species need be screened from wind to avoid damage to foliage. The earlier-blooming kinds do better if fully exposed to March winds, lest the petals be blighted by late frosts.

Transplanting is successful in spring before the flowers open if the roots are dug with a soil ball and wrapped securely [balled and burlapped]. Magnolias do not always respond favorably to severe pruning, but if only young wood is cut, both shape and flowering may be improved. The safest procedure is to remove unwanted shoots while they are still slender.

The only serious insect pest is the tulip-tree scale (*Toumeyella liriodendri*). This can be controlled in early September by spraying the vulnerable crawlers with malathion. In 100 gallons of water use either one quart of 50 to 57 per cent emulsifiable solution, or four pounds of 25 per cent wettable powder.

In the landscape, magnolias are usually planted as free-standing lawn specimens or groups. The average-sized home grounds can accommodate only a single tree. Some species, by special nursery

training, are adapted to streetside and parkway planting. The saucer magnolia (*M. soulangeana*) is especially useful, for it is one of the few woody plants that can withstand extreme city conditions.

All magnolias are handsome trees throughout the year. While some may be partially evergreen in favored situations or seasons, the only true broad-leaved evergreen in the group is the native *M. grandiflora*. Some species bear scented flowers. The following list, arranged in approximate sequence of bloom from early spring to mid-summer, includes the best species and clones presently known for ornamental use. The first seven are of Asiatic origin, the remaining six are American.

Asiatic—Flowers mostly appearing before the leaves

Star magnolia (*M. stellata*), a shrub-like form, bears 3-inch fragrant flowers with ribbon-like petals of white to delicate pink ('Waterlily' and 'Rubra'). The plant is slow growing, developing into a globe-shaped shrub 8 to 10 feet tall. Elliptic to obovate leaves, 2 to 4 inches long, produce a soft-textured, dark-green



Roche

M. soulangeana is one of the few magnolias that can thrive in cities.

foliage. Slender branchlets are capped by plump fuzzy buds in winter. As an early bloomer, star magnolia is often touched by frost in north temperate climates.

The graceful 20-foot **kobus** (*M. kobus*) bursts into bloom a few days after the star magnolia. Its broad creamy-white flowers almost hide the bare branches. Leaves, which are obovate and abruptly pointed, are longer and broader than those of the star magnolia. The tall tree form (var. *borealis*) has leaves up to 6 inches long. This is the hardiest of the Asiatic magnolias and is finding use along our streets. 'Wada's Memory' is a noteworthy selection. *Kobus* is, however, not a choice species.

Anise magnolia (*M. salicifolia*) is a slender symmetrical tree to 20 feet tall with fragrant white flowers. The taper-pointed, light green leaves, 3 to 5 inches long, emit a strong scent of anise when bruised. The excellent foliage and early bloom make this species seem ideal for street-side planting. The **Slavin magnolia**, a promising hybrid between this and the saucer magnolia, is a free-flowering vigorous tree with upright branches.

Most popular among magnolias is the free-blooming pink-flowered hybrid **saucer magnolia** (*M. soulangeana*). It grows as a globe-shaped tree, usually 15 to 20 feet tall. Large cup-shaped flowers are variously colored on the outside from deepest rosy purple ('Lennei') to creamy white, the commonest being those with petals suffused soft pink on the outside,



McFarland

The short-lived flowers of the kobus magnolia are 4 inches or more in diameter.



Genereux

The star magnolia (*M. stellata*) is the first of the genus to bloom in spring.

white inside. Many clones have been described. Leaves are obovate, more than 4 inches long, pale green above and somewhat hairy beneath. The bark is smooth and brown, becoming gray with age; winter buds are plump and fuzzy. This is a hybrid between *M. denudata* and the lily magnolia (*M. liliiflora*). The lily magnolia is a shrublike Chinese species with white and purple flowers, best known in its hardier variety *nigra*, which bears

many large, dark purple flowers, 4 to 5 inches across.

Yulan (*M. denudata*) is possibly the handsomest of the large-flowered magnolias. An early bloomer, sometimes nipped by frost. Six-inch flowers are lemony-white to white and somewhat fragrant. Ultimately a large tree.

Silverleaf magnolia (*M. obovata*) has yellowish-white, sometimes pink flowers

McFarland



Flowers of the star magnolia are three inches across and fragrant. Sometimes touched by frost in northern regions.

that unfold after the leaves. It is a tall tree which, in size and flowering, is the Japanese counterpart of our ever-green bull-bay. A subtle fragrance is emitted by the flowers. The leaves are large, 8 to 16 inches long, obovate, and pale on the under side.

Oyama (*M. sieboldii*) is a small tree which may be shrublike. Nodding white bell-shaped flowers, up to 4 inches across, appear *after* the leaves. Red anthers are hidden deep within the bowl of the corolla. The flowers produce an exquisite fragrance. The leaves are elliptic to obovate, 3 to 6 inches long. Deserves to be more widely planted.

American—Flowers opening after leaves expand

Cucumber-tree (*M. acuminata*) grows to magnificent proportions with a massive straight cinnamon-brown trunk. Upsweeping branches in youth become pendent in age to form a symmetrical, broadly oval crown. Ovate leaves 6 to 12



Roche

The fragrant Oyama magnolia (*M. sieboldii*) is one of the few Asiatics whose flowers appear with the leaves.



McFarland

Anise magnolia (*M. salicifolia*) has fragrant white flowers and, later, anise-scented leaves which are slender and light green. The tree is also slender.



McFarland

The silverleaf magnolia (*M. obovata*) has creamy-white flowers that open among young leaves. Later the leaves may become a foot long, pale on the lower surface.



Roche

The umbrella-tree (*Magnolia tripetala*) of the southern Appalachians has leaves sometimes two feet long surrounding the large white musky-scented flowers.

inches long expand as the 3-inch greenish-yellow flowers unfold. This native eastern tree takes its common name from the immature cone's fancied resemblance to a cucumber. The species is beginning to find favor as a shade tree. It is free from insect pests.

Yellow cucumber-tree (*M. cordata*) is smaller than *M. acuminata*. Its canary-yellow petals are smaller too, but the flowers are more conspicuous. Native from New York to Georgia, and westward to Illinois and Arkansas, this tree is adapted to northern latitudes, where it reaches a height of 35 to 40 feet—about half its size in the South.

Umbrella-tree (*M. tripetala*), a small tree of the southern Appalachian Mountains and the Mississippi Embayment regions, bears large leaves arranged like an umbrella's ribs at the tips of the smooth green branches. Large white musky-scented flowers appear with the newly expanding foliage. The leaves, 12 to 24 inches long, taper at either end

and are whitish beneath. Winter buds are smooth. Cylindrical cones, 3 to 4 inches long, turn pink in August and remain decorative as long as the foliage lasts.

The southern **large-leaved magnolia** (*M. macrophylla*) is only a medium-sized tree despite the occasional 30-inch length of its leaves. The fragrant creamy flowers of June measure up to 12 inches across when fully opened. Hairy buds and basal lobes on the leaves distinguish this species from the umbrella tree. Both have such coarse-textured foliage that their use in small landscapes is scarcely recommended.

Sweet-bay (*M. virginiana*), a small tree or large shrub of the Atlantic Coastal Plain, bears rhododendron-type leaves which are whitish beneath. Small fragrant white flowers appear on green twigs in June and continue to open sporadically throughout the summer. In late August the fruiting "cones" of scarlet seeds contrast beautifully with the gray-green foliage.



McFarland

The bull-bay (*Magnolia grandiflora*) of the South bears large sweet-smelling white flowers intermittently through the summer.

Bull-bay or southern magnolia (*M. grandiflora*) is a tall evergreen with handsome dark glossy-green leaves that are rusty beneath. Its fragrant white flowers, 6 to 8 inches across, can be seen throughout the summer months. The species is variable in its reaction to climates colder than its native habitat, and many attempts have been made to find better adapted specimens. Besides such selections as 'Goliath' and 'Samuel Sommers,' hybrids have been made with the hardier sweet-bay. Highest hopes, however, seem to be in locating established plants that have withstood low temperatures and propagating from them.

EDITOR'S NOTE: The Brooklyn Botanic Garden has been engaged in a magnolia breeding program since 1953, the chief aim of which is the production of hardier, later-blooming varieties. Testing of new hybrids is carried on at the Garden's field station in Kitchawan, New York.

Probably the largest specimen of *Magnolia grandiflora* in the Greater New York area is a tree nearly a century old that grows in a sheltered location on Lafayette Avenue, Brooklyn, only a few miles from the Botanic Garden. An almost identical photograph of this magnolia, made by Louis Buhle more than thirty years earlier than this, shows that the tree remains "trimmed" at the level of the rooftop.

Buhle



McFarland

Waxy-white flowers of the bull-bay, or southern magnolia (*M. grandiflora*), are fragrant and often measure 8 inches across.

MAGNOLIA SOULANGEANA —ITS ORIGIN

(With acknowledgement to Alice M. Coats: *Garden Shrubs and Their Histories*, Vista Books, London, 1963.)

THE first of these [the group of hybrids known as *M. soulangeana*] was raised from some seeds of a specimen of *M. denudata*, which stood near one of *M. liliflora* in front of the château of M. Soulange-Bodin at Fromont, near Paris; it flowered in 1826 and proved to be an accidental hybrid between the two species. (The Chevalier Soulange-Bodin was an army officer who retired after the peace of 1815, and devoted himself to gardening; he was the founder of the National Horticultural Society of France.)

In this country [England] the new magnolia was distributed by the firm of Young at Epsom, who procured plants from M. Soulange-Bodin as early as 1828. It rapidly became the most popular of all the sorts for smaller gardens. . . . A number of named forms have since been raised from the same cross, nearly all . . . with the wine purple of . . . *liliflora*.

FLOWERING DOGWOODS

*A chance for discovery:
Many fine kinds are available*

Clarence E. Lewis

UNUSUAL forms of the flowering dogwood (*Cornus florida*) are constantly being sought by plantsmen. It was apparently the early discovery of a pink form in the wild that gave American gardens their first pink dogwood trees more than two hundred years ago. While several variants were introduced in these first two centuries of culture, there is a

surge of interest now that is bringing increasing numbers into landscape planting. Color, size, shape and number of the conspicuous bracts that surround the flowers distinguish some of the new types. Others are noteworthy for tree size or branching habit.

How much difference there is among some of the introductions is debatable,

Flowering dogwood (*Cornus florida*) is one of America's best-loved native trees for landscape use.

Gottscho-Schleisner



The Chinese variety of kousa dogwood (*Cornus kousa chinensis*) flowers a month later than the well-known American *Cornus florida*.



Genereux

but a few are definite improvements over the kinds commonly sold. For one person to rate one dogwood variety over another is difficult. Therefore, in the listing that follows, comments of users are given wherever possible.

Choice White Dogwoods

'Cloud 9' (Plant Patent No. 2112) has flowered profusely and with large bracts at an early age in Lansing, Michigan. Some Louisville, Kentucky, growers have told of plants 3 feet high with 55 sets of bracts and flowers. Another user from Elsberry, Missouri, has reported a tree not much taller with 93 inflorescences.

The bracts are oval and they overlap to give a disk-like effect rather than the traditional cross. The tree has a spreading growth habit and the bark has a lighter gray tone than the average. (Introduced by the Chase Nursery Company, Chase, Alabama.)

Another seedling that flowers at a very early age has been found by Hillenmeyer Nurseries of Lexington, Kentucky. Newly budded trees of this selection flowered when 2 to 3 feet tall.

Some noteworthy qualities are to be

observed in these selections of white-bracted dogwoods:

'Gigantea'—bracts 6 inches long (found by Paul Vossberg of Westbury Rose Company, Westbury, New York).

'New Hampshire'—flower buds unlikely to show winter injury (a hardy selection made by Heinrich Rohrbach, Heatherfells Nursery, Andover, Massachusetts, from a tree at Atkinson, New Hampshire).

Additional improved white dogwoods that are worth investigating and acquiring include: 'Tingle White' (Tingle's Nurseries, Pittsville, Maryland); 'Cherokee Princess' (Crimson Dale Nursery, Winchester, Tennessee); 'White Cloud' (Wayside Gardens, Mentor, Ohio); 'Weaver' (available from several nurseries).

Red and Pink Forms

Many selections have been made of the red- or pink-bracted variation that goes under the general name of *Cornus florida rubra*. It is difficult to rate one over the other until they have been observed over a period of time and under variable growing conditions. A selection that has been hailed as a much deeper red may be only a light pink in regions where grow-



Gartner

Cornus florida, whose flowers open on bare branches, has indented tips on its four bracts. The true flowers, clustered in the center, develop in the fall into separate red berries.

ing conditions are different. This happened to one of the early ones, 'Rose Valley.'

Some of the deeper-colored forms have a tendency to fade. A recent introduction with bracts that do not turn pale is 'Cherokee Chief' (Plant Patent No. 1710). A reddish tinge is carried into the twigs. A vigorous cultivar.

Other worthy reds and pinks include these named varieties:

'Sweetwater,' with good spring and fall foliage color (Howell Nurseries, Knoxville, Tennessee).

'Apple Blossom' and 'Spring Song,' two new pink selections, the latter described as a gorgeous rose-red (Wayside Gardens, Mentor, Ohio).

'Prosser,' introduced some time ago with good results reported by some growers.

'Super Red' (Kelsey Nursery, Highlands, N. J.).

'Royal Red' (Girard's Nursery, Geneva, Ohio).

'Belmont Pink,' first reported by Henry Hicks, Westbury, Long Island, seems to have disappeared.

Other Variations

To obtain any of the following kinds may require a bit of searching:

Cornus florida pendula, weeping form, with a pronounced hanging branch habit which extends to the bracts as well. Not a profuse bloomer.

C. f. fastigiata, a narrow or fastigate form, the branches extending upward close to the trunk.

C. f. pyramidalis, also fastigate.

C. f. xanthocarpa, yellow fruits with reddish cheek. Birds seem to prefer the red fruits.

C. f. salicifolia, the leaf slightly narrower.

'Magnifica'—large, rounded bracts (reported in 1926).

'Welchi,' variegated foliage.

The double-bracted flowering dogwood is listed by several names: *pleuribracteata*, *flore-plena*, *plena*, and *multibracteata*. It is seldom considered as attractive as the single form with its four symmetrical bracts.

The Kousa Dogwood

The dogwood that is noticed about a month later than *Cornus florida* is *C. kousa*, the Japanese or kousa dogwood. It too has rightly won the favor of many gardeners. Appearing in June, the flowers are set among the leaves, instead of on bare branches, as in *Cornus florida*. The four surrounding bracts, which are pointed at the tip, are greenish at first, then gradually change to a beautiful creamy white. They are long lasting and some turn pink with age.

A pink-flowering form that originated in Henry Hohman's Kingsville Nursery, Kingsville, Maryland, was named *Cornus kousa* 'Rubra' by B. C. Blackburn. The bracts, at first a soft pink, later darken to rose pink.

The Chinese kousa dogwood (*C. k. chinensis*) has larger bracts than the species. The whole plant, including the foliage, appears to be more vigorous.

'Milky Way' was selected by Wayside Gardens from a Chinese kousa that flowers within two years after transplanting. (Most dogwoods require a longer period to become established.) In later years it produces outstanding bloom.

C. k. variegata has light markings on the leaves.

The fruits of *Cornus kousa* are like large purplish-red raspberries, the entire aggregate on a single stalk. Those of

Cornus florida are single-seeded, clustered, and bright red, each on its own short stalk.

Autumn Effects

The fall colors of both *Cornus florida* and *C. kousa* and their variations are extremely attractive, especially with the complement of their bright red fruits. The reds of the leaves are produced in varying intensities with a bit of blue coloring slipped in and occasionally a slight touch of yellow. Ordinarily the native dogwood is the more brilliant of the two, but *Cornus kousa* has a more subtle way of organizing its fall coloration—no artist could do as well.

Western Species

Along the Pacific Coast, from British Columbia to California, *Cornus nuttalli* puts on a tremendous display on its horizontal branches in May. The bracts usually number six, and are more slender than those of the eastern species. Some forms are pale pink instead of the usual white. The fruits, which resemble those of *Cornus florida*, are orange-red. The tree is difficult of culture except where it is native.

Dogwood on View

In addition to the numerous dogwood displays along highways in the East, there



Roche

Cornus kousa, whose flowers appear amid full-grown leaves, has pointed bracts. The tightly clustered flowers in the center develop a single soft-red raspberry-like fruit in autumn.

are several good collections of dogwood species and varieties. Outstanding is the Cornus Arboretum in Cedar Brook Park, Plainfield, New Jersey, started in the early thirties by the Plainfield Garden Club.

If a poll were to be taken of landscape architects, gardeners, plantsmen, nurserymen, horticulturists, and home gardeners as to what one flowering tree best exemplifies the history and the image of American gardening, it would undoubtedly be the eastern native flowering dogwood, *Cornus florida*.



DOGWOODS IN A DIFFICULT REGION

DOGWOODS cannot be successfully grown in all areas, and the vicinity of the Morton Arboretum at Lisle, Illinois, lies in a region where annual bloom is never certain. Some wild plants from Michigan, however, have done better there than nursery-grown specimens. Without venturing an explanation of the reason, here is the story of these dogwoods as communicated by Clarence E. Godshalk, Director.

"A number of years ago we got the idea of moving in plants we could dig from Michigan woods, which are northern limits of flowering dogwoods in this area. The soil in Michigan from which they were dug is quite a sandy clay loam

and some of it tests 4.5 in acidity.

"In contrast to the balled and burlapped plants we had previously obtained from a nursery, we pried these plants out with as much dirt as would cling to the roots. They varied in size from 18 inches to 8 feet. The greatest percentage of them have grown in the Arboretum in our heavy soil, which is from only slightly acid to alkaline.

"These Michigan plants are doing best where our soil is underlaid with gravel, and they seem to prefer east and north slopes. The blooms are larger and whiter than the ones on the nursery plants, even though the plants are younger and smaller."

SUMMER-FLOWERING TREES

John M. Fogg, Jr.

BETWEEN spring- and summer-flowering trees there is one notable distinction: the first generally produce their flowers before the leaves; the second, after the tree is in full foliage.

Some early bloomers, such as poplars, hickories, walnuts, oak, beeches and elms, bear inconspicuous flowers in catkins or small clusters. These are wind-pollinated. Others, among them cherries, crab apples, pears and most Asiatic magnolias, are pollinated by insects. This group includes some of the showiest of all trees, the profusion of flowers often completely obscuring the branches.

In summer, when there is a dense crown of foliage on the trees, the problem of attracting insect visitors is solved in a variety of ways. The American magnolias, kousa dogwood, stewartias and the Franklin-tree produce large white or cream-colored flowers that stand out boldly against the leafy background. In other genera the individual flowers are smaller but are borne at the tips of the branches in showy panicles or racemes. This category includes the yellow-wood (*Cladrastis*), silk-tree (*Albizia*), black locust (*Robinia*), goldenrain (*Koeleruteria*), raisin-tree (*Hovenia*), sorrel-tree or sourwood (*Oxydendrum*), and the tree lilacs and catalpas. With but few exceptions the flowers of these species are white.

Still another group depends on scent. The flowers of the lindens, for example, are inconspicuous, but their fragrance and nectar production invite myriads of insects, mostly honey-bees.

In the account which follows, the term "summer" is somewhat arbitrarily adopted as beginning the first of June, and the species are arranged in approximate order of blooming. The dates cited are those which have been established for the Philadelphia area. The flowering times for New York and Boston should be, respectively, one and two weeks later.



McFarland

Outstanding among the trees that flower in mid-June is *Stewartia koreana*, the Asiatic counterpart of the shrubby species of America. It is related to the less hardy camellia.

Early June

Cladrastis. The American yellow-wood (*C. lutea*) comes into flower toward the end of May, but continues to produce its pendulous racemes of fragrant white pea-like flowers throughout early June. Its smooth light bark and pinnately compound leaves make it attractive even when not in bloom. Two Asiatic species, *C. sinensis* and *C. platycarpa*, are occasionally found in cultivation. The black locust (*Robinia pseudoacacia*), is a close relative with a similar flowering period.

Liriodendron. The greenish-yellow and orange flowers of the tulip-tree (*L. tulipifera*) are so nearly concealed by the foliage

and are borne so high that they often escape notice. The numerous spirally inserted stamens and carpels proclaim this genus a near ally of the magnolias.

Magnolia. Most of the American species belong to the flora of late spring or early summer, the flowers following the leaves. The large-leaved magnolia (*M. macrophylla*), which possesses the largest leaves and flowers of any tree hardy in our area, comes into bloom in early June. It is followed shortly by the sweet-bay or swamp magnolia (*M. virginiana*) with creamy white fragrant flowers and semipersistent glossy foliage. The large waxen flowers of the bull-bay or southern magnolia (*M. grandiflora*) will have opened in mid-May. Toward the end of June they will still be in evidence against their background of lustrous evergreen leaves. This species is perhaps the most widely cultivated tree in the world.

Cornus kousa. The Asiatic relative of the eastern American flowering dogwood blooms a month later than the native species and frequently provides a display until early July. This is one of the most desirable of small hardy trees.

Styrax. The Japanese snowbell or storax (*S. japonica*) is an attractive low-branched tree up to 25 or 30 feet in height. Its closely-ranked dark green leaves partly conceal

The snowbell or storax (*Styrax japonica*), blooming in early June, is most effective when the pendent flowers are seen from below.



McFarland

The tulip-tree (*Liriodendron tulipifera*) of eastern United States is a tall straight-trunked tree with large decorative flowers in early summer. (See also the color plates.)



McFarland



McFarland

Clusters of white flowers resembling locust blossoms hang from the outer branches of the yellow-wood in early summer.

the pendent white bell-shaped flowers. The tree is therefore most effective when planted on a bank, so that the flowers may be seen from below.

Mid-June

Catalpa. When afforded adequate space and light, the catalpas are capable of developing into handsome trees. Their terminal trusses of large white flowers stand out boldly against the background of bright green heart-shaped leaves. *C. bignonioides* of the Southeast is usually in full bloom by mid-June; *C. speciosa* of the Midwest generally two or three weeks later.

Syringa. Most of the thirty-odd species of this genus are shrubs. However, the Amur lilacs (*S. amurensis* and its variety *japonica*) grow as trees of 30 to 35 feet. The large terminal panicles of white flowers make them extremely showy in full bloom. The closely related *S. pekinensis*, although primarily a shrub, is almost as tall and quite as handsome as *S. amurensis*.

Pterostyrax. The epaulet-tree (*P. hispidus*) is a fragrant species from Japan, related to the silverbell (*Halesia*). Its creamy-white flowers with prominent stamens hang from the branches in large loose clus-

ters. The tree may reach 40 feet in height.

Stewartia. In contrast to the shrubby American species, several of the Asiatic stewartias are trees. *S. koreana*, perhaps the most widely cultivated, is often 35 or 40 feet tall and *S. pseudo-camellia* and *S. monadelphus* may be even taller. All species have attractive white flowers, often 3 or 4 inches across, with a central crown of golden stamens. The smooth flaky bark peels off in varicolored patches, reminiscent of the trunk of the buttonwood or plane-tree (*Platanus*).

Late June

Albizia. The hardy silk-tree (*A. julibrissin*), often incorrectly called "mimosa," provides a continuous show of delicate pinkish "powder puffs" against the finely divided foliage from late June until late August or early September. The variety *rosea*, with bright pink flowers, appears to have a longer period of bloom than the species, is hardier, lower growing, and appreciably more fragrant after dusk.

Hovenia. The raisin-tree (*H. dulcis*), is a Chinese member of the *Rhamnaceae* or Buckthorn Family. Though not reliably hardy north of Philadelphia, it is a handsome plant deserving of wider use. It may attain a height of 35 or 40 feet. Its large, ovate, dark green leaves provide a lustrous background for the flat-topped cymes of pure white flowers between late June and mid-July. The common name derives from the dark-colored raisin-like drupes.

Koelreuteria. The China-tree, also known as goldenrain or varnish-tree (*K. paniculata*), is the only hardy summer-blooming tree with yellow flowers. A member of the

A yellow-wood tree (*Cladrastis lutea*) in full bloom.

McFarland





Roche



McFarland

Flowers and fruits of the hardy silk-tree (*Albizia julibrissin rosea*).

Sapindaceae or Soapberry Family, it is native to China, Korea and Japan. Its large panicles of golden flowers appear late in June and continue into July. They are supplanted by bladder-like capsules, which turn russet-brown by late summer.

Maackia. The maackias are related to the yellow-woods and, like them, have pinnately compound leaves. The most widely grown species (*M. amurensis*), a tree up to 30 or 40 feet, has dense ascending racemes of creamy-white flowers which extend beyond the branchlets. It continues to bloom well into July.

July

Cedrela. A member of the *Meliaceae* or Mahogany Family, *C. sinensis* is the only representative of its genus hardy in eastern temperate North America. Known as Chinese cedrela (sometimes as toon or toona), it is a tall graceful tree with pinnately compound leaves (which superficially resemble those of *Ailanthus*) and long drooping racemes of creamy-white flowers which usually appear during the first week of July. The species deserves to be more widely planted as a street tree.

Oxydendrum. The sourwood or sorrel-tree (*O. arboreum*), one of the few arboreal examples of the *Ericaceae* or Heath Family,

is native to the eastern and southeastern United States, where it may attain a height of 75 or 80 feet. When grown farther north its height is less. Its small whitish bell-shaped flowers appear in early July.

Sophora japonica. Despite its specific name, the pagoda-tree or scholar-tree is native of Korea and China. Related to our American yellow-wood, it is a handsome tree with spreading branches forming a broadly rounded head. The lustrous pinnately compound leaves provide a fine background for the terminal panicles of creamy-

The goldenrain-tree (*Koelerutria paniculata*) is the only hardy tree with showy yellow flowers in summer.

Genereur





Genereux



McFarland

Bright yellow flowers of the goldenrain-tree are followed in autumn by russet-brown fruits.

colored flowers which appear in late July. The pods which form in late summer are constricted between the seeds, giving the appearance of a chain of beads.

August

Evodia. The genus *Evodia* belongs to the Rue Family (*Rutaceae*), which also includes the prickly-ash (*Zanthoxylum*), the cork-tree (*Phellodendron*) and the citrus fruits. The evodias have opposite, pinnately compound leaves and unisexual greenish-white flowers which are borne in large terminal or axillary clusters. Of the half-dozen species, the principal one and the hardiest is *E. danielli*.

Though it is the leaves rather than the flowers which offer fragrance, the tree is a favorite with honey-bees, which "work" it in audible swarms. It has therefore become popular among apiarists.

Franklinia. The famous Franklin-tree (*F. alata*) is almost the last tree, hardy in temperate climes, to produce its flowers. In the Philadelphia area the large white corollas surrounding numerous golden stamens may be expected to unfold about the end of the first week in August. From then until early September this handsome small tree delights the eye with its attractive delicate blossoms.

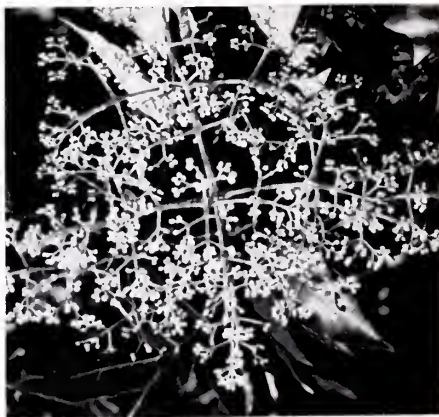
The raisin-tree (*Hovenia dulcis*) bears fleshy clusters of greenish-white flowers.

Fogg



Evodia danielli is the hardiest species in this warm-climate Asiatic genus.

P. Allison



UNUSUAL SHAPES

Columnar and weeping forms in flowering trees

Jake Gerling

ALTHOUGH upright and pendulous forms of numerous tree species have been in cultivation for many years, such variants, especially the narrow-headed types, were long considered suitable only for occasional landscape use. Today, however, the need for compact forms of trees on small home plots has focused attention on varieties that require little space at maturity. This current demand, together with the modern home-owners' broadening knowledge of arboriculture, has induced nurserymen to provide an ever-increasing number of space-saving cultivars.

While structural mutations are not numerous among ornamental woody plants, there are some fastigiate and pendulous flowering trees that are well adapted to planting where space is limited. The upright and weeping forms described below are useful as ornamental specimens on a home-site or as pleasing and practical trees along a city street.

Asiatic Cherries

Always highly favored for their spectacular bloom are the Asiatic ornamental cherries. Among these, a truly columnar form is *Prunus serrulata* 'Amanogawa,' the Milky Way cherry. The generously borne, semidouble pink-tinged flowers make this a small tree of impressive beauty as well as functional usefulness. It is reasonably hardy, thriving in Zone V and parts of Zone IV, as shown on the hardiness map in Rehder's *Manual of Cultivated Trees and Shrubs*. (This Zone IV approximates Zone V on the plant hardiness map published by the United States Department of Agriculture.

Of all the colorful Japanese cherries the hardiest and most vigorous is the Sargent cherry (*P. sargentii*), of which a columnar form is offered by Edward H. Scanlon and Associates. It is compact, well proportioned and nicely contoured, handsome in bloom and attractive in fall

color. Not strictly columnar, but of very upright habit is *P. serrulata* 'Sekiyama,' a Kwanzan cherry with a head resembling an inverted cone. The stiffly ascendant branches are lavishly adorned with clusters of large, deep rose-red flowers that well justify the tree's popularity.

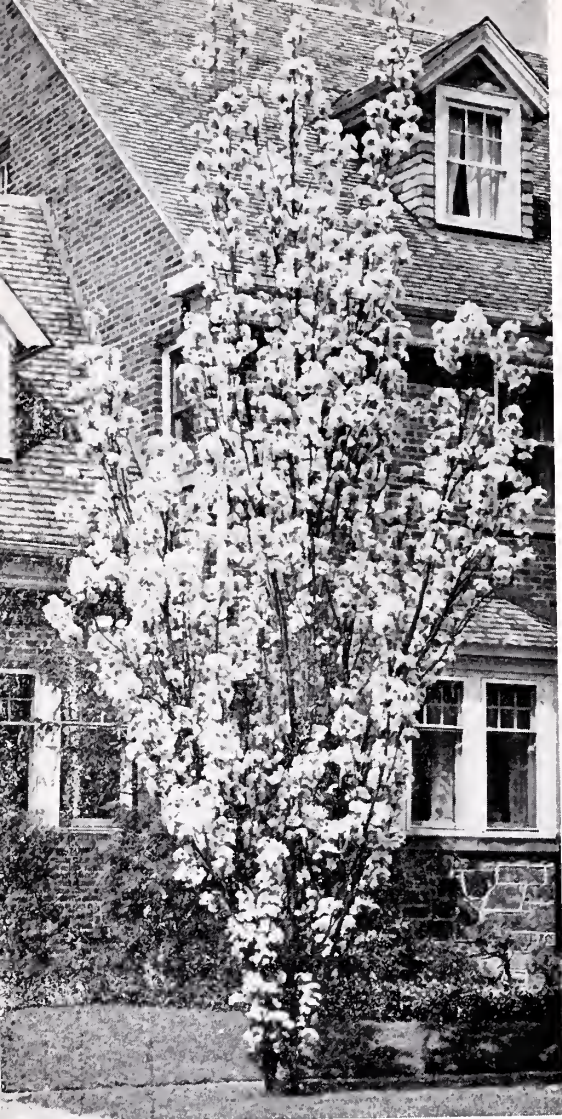
Introduced one hundred years ago, the pendulous variety of the Higan cherry (*Prunus subhirtella*) is one of the most widely cultivated of weeping trees. A small free-flowering tree in which many slender, drooping branches are mantled with light pink bloom, its fountain-like head presents a picture of graceful splendor. The species, being upright, can rise to 35 feet, but the pendent habit of var. *pendula* keeps mature height to considerably less, and makes it especially suitable for the grounds of low-roofed houses. 'Yae-shidare' is a pendulous form with double flowers. Both are hardy in Zone V and parts of Zone IV, according to the Rehder map, and, like most species in the genus, the Higan cherry does well on light soil with a modicum of nutrients but will not tolerate "wet feet."

Weeping Dogwood

The weeping form of the flowering dogwood (*Cornus florida pendula*) is an interesting addition to our choice of small pendulous flowering trees. While it has the desirable characteristics of the species itself in flower, fruit and foliage, it has one objectionable trait. Unless it is a well cultured specimen, it is prone to develop an asymmetric head in which irregular drooping branches give the tree a rather distressed appearance. On the other hand, properly grown and groomed, the pendulous form of *C. florida* is an impressive ornamental of charming grace.

Variations in Crab Apples

Many species and hybrids of the crab apple (*Malus*) have been extensively used in landscape work for centuries. A



Gerling

The upright branches of the Milky Way cherry (*Prunus serrulata* 'Amanogawa') allow for views from windows when planted in front of a house.

few have developed upright branching patterns that form the columnar and pyramidal heads needed in situations where space limits one's choice in flowering trees. One of the best upright forms, offered by growers as 'Flame,' matures to about 20 feet with a pyramidal head carrying single, bright pink flowers and freely produced scarlet fruit. While not compactly columnar, the midget crab (*M. micromalus*) is of upright habit

and merits consideration where an attractive flowering tree of small dimensions is wanted, because of its large, fragrant flowers of bright pink and persistent, very small red fruits. Also known as the Kaido crab, *M. micromalus* is one of the handsomest of the hardier crab apples.

Weeping crab apples available are 'Pink Weeper' and 'Red Jade.' Though not fully pendulous, these cultivars are of graceful habit and are pleasing in flower and fruit. 'Pink Weeper' grows to 15 feet and is hardy in Zone IV. The dark



Gerling

The Sargent cherry (*Prunus sargentii*) in its upright variety is appropriate for roadside planting.



Scanlon

The anise magnolia occurs in a columnar variety (*M. salicifolia fasciata*).



Genereux

The Nanking or Manchou cherry (*Prunus tomentosa*) sometimes grows as a small, upright-branching tree.



Gerling

The weeping variety of flowering dogwood (*Cornus florida*) is seldom a satisfactory tree.

red buds open into pink flowers. 'Red Jade' is a somewhat spreading, partly-weeping form, with pink buds opening white and an abundance of cherry-size bright red fruit. Both these selections are hardy in Zone IV and 'Red Jade' can be grown in parts of Zone III.

Upright Magnolia

Unusual in the genus *Magnolia* is the branch formation of *M. salicifolia fasciata*. Maturing as an arborescent shrub to about 25 feet with much ramified, upright branches, forming a columnar head, this variant of the willow-leaf magnolia, like the species, is one of the hardiest and earliest bloomers in the group. The abundant flowers are white, marked with purple at the base. The upright variety merits much more general use where a compactly fastigate tree of moderate height and narrow width is required. The aroma of anise in the foliage, when it is crushed, in contrast to the lemon-verbena scent of most other magnolias, gives this tree an added attraction.

FLOWERING TREES FOR CITY STREETS

Edward H. Scanlon

THE streets of American cities, until recent years, have been planted almost exclusively with trees that in time grew to gigantic size, produced no conspicuous flowers, and often damaged sewage sys-

tems with their roots. Today in an increasing number of places city planners are learning the value of small or medium-sized trees, especially flowering trees, on streets.

The reaction of the public to streets planted with Japanese cherries, crab apples and hawthorns is exactly what would be expected from people who had formerly seen such trees only as isolated specimens in botanic gardens, parks or on large homesites. They love them! I have observed this for the past 16 years, in the City of Cleveland and the Cleveland area, where I have planted and advised the use of numerous small-type flowering trees. The value imparted by such trees to streets and cities is inestimable.

Culturally, the flowering trees are a bit more difficult to establish than the elms, silver maples, and other out-sized trees on streets. But the lack of maintenance, absence of costly conflicts with sewage systems and, of greatest importance, the low removal cost, far outweigh the initial cost of establishment and replacement.

Another unfortunate practice of the past was the overplanting of one species. Dutch elm disease has cost many millions of dollars and will cost hundreds of millions more before it runs its course. The fact that there is no cure in sight should teach us not to put all of our eggs in one planting basket.

In compiling Master Street Tree Plans for 72 cities and towns in the Greater Cleveland area, I have specified no more than 6 to 10 per cent of any one species to be used in a particular area, and I am convinced that this is the only sensible way to approach a street tree program. In this experience, in which about 40,000 trees have been planted according to plan,



Scanlon

Japanese tree lilacs (*Syringa amurensis japonica*) grow and flower successfully on a street in Cleveland, Ohio.

the reaction of the public to flowering trees is overwhelming.

Four trips through dozens of beautiful European cities plus a round-the-world trip, have produced more than enough evidence of the soundness of planting small flowering trees along streets. Europeans, who have been engaged in this sensible practice for 50 to 100 years, are ahead of us as street tree planters.

Cherry Blossoms for the Streets

Japanese cherries—varieties of *Prunus serrulata* and *P. subhirtella*—give excellent results on streets. To function best, these varieties must be grafted at 6 to 6½ feet, preferably on a Mazzard (*P. avium*) understock. When budded low, they do not develop their own trunk, which does not have the thermostatic ability to resist fast temperature changes. This deficiency is particularly devastating in the winter months and restricts the range of the tree appreciably. The Kwanzan (or Kanzan) cherry grafted on a high Mazzard stem is growing beautifully in a city in mid-central Michigan, where winters are apt to be severe.

Other outstanding cherries that are being used successfully are 'Kofugen,' a tree with deeper pink flowers than 'Kwanzan,' the well known white 'Mt. Fuji,' and 'Akebono.' The latter, meaning Daybreak,



Scanlon

The Callery pear (*Pyrus calleryana*) is a fine-looking tree when in full bloom. Here it is used as a street tree in Cleveland.

is covered in May with long pink buds that gradually open to a lovely white. 'Tai Haku' is a more loosely crowned tree than most *P. serrulata* varieties but bears the largest white flowers (four-inch diameter) of all.

'Yedo Zakura' is my favorite. It is an apple blossom in reverse, except that it is double. Pink predominates with the white imparting a delicate contrast that produces exclamations of awe. The same can

The Scanlon Globe cherry (a form of *Prunus avium*) is seen here flowering along a street in Holland.

Scanlon





Scanton

Lavalle hawthorns (*Crataegus lavalleyi*) are kept cut back to hold them within bounds on this Belgian business street.

be said of 'Daikoku.' The reddish-pink petals of 'Daikoku' are frilled and there is just enough white to impart a daintiness not possessed by the garish 'Kwan-zan.' *P. sieboldi* and 'Hokusai' are of this same general tonal quality, yet they differ sufficiently to have distinctive individuality.

Among the varieties of *Prunus subhirtella*, there are several superb trees whose smaller, finer-textured foliage gives them a summer quality that the coarser-leaved forms of *P. serrulata* do not possess. The flowers are not as large, but are almost as showy because of their profusion. 'Pandora' comes out with a faint pink tinge and fades to white. It is a sea of flowers for a long period. All of these early cherries flower well before the *P. serrulata* varieties. 'Okame' and 'Fukubana' (Spring Glory) are lovely. Dark coloring with a bit of salmon tinting makes them a real show. 'Ascendens' has an oyster-white double flower that smothers the fine twigs with a delicate charm. All of the types will grow to 18 or 20 feet.

A small round-headed grower is the Scanton Globe cherry (*Prunus avium* 'Scanton'). Worked on a seven-foot stem

it makes a splendid street tree under low wires, reaching not more than 14 feet in height. Its white single flowers (sterile) are borne in great profusion over a two-week period.

The two finest large-size cherries are the Sargent and the double-flowered Mazzard. The miniature rose-like flower-clusters of the double Mazzard, its broadly conical form and clean foliage make it a magnificent street tree. It is in wide use in Europe. Grafting it on a seven-foot understock reduces maintenance to a minimum.

The Sargent is peerless. Its nice round crown of dark green foliage turns a brilliant red in the fall. In the spring it is covered with a mass of light pink flowers.

The Rancho Columnar Sargent (*Prunus sargentii* 'Rancho,' Plant Patent 2065) is proving to be an excellent tree. It grows to 25 feet and is fine for screening, as an accent, or for use on narrow streets.

A cherry that will one day become a favorite, if for no other reason than its showy golden bark, is the Amur cherry (*Prunus maackii*). It also bears attractive racemes of white flowers, good green foliage and has a nice round-headed form.



Scanlon

Hawthorns of columnar form (*Crataegus monogyna stricta*) have been planted on this wide street in Breda, Holland.

Useful Mountain-ashes

Two little-known species of *Sorbus* deserve high acclaim: *Sorbus folgneri* and *S. alnifolia*. *S. folgneri* is a graceful little tree with the branch tips slightly pendulous. The leaf is a rich green with silver underneath, a pleasing sight when slightly ruffled in a breeze. The flower is white and the fruit, in loose panicles, is reddish. *S. alnifolia*, the Korean mountain-ash, is best liked for the salmon hues of its foliage in fall and the multitude of loose holly-like berries.

The Choicest Hawthorns

Paul's Scarlet hawthorn is well known, as is the double white English. Lesser known but in many ways superior as a street tree is the Lavalley hawthorn (*Crataegus lavalleyi*). This has been demonstrated in many street plantings observed in Switzerland, Holland and Oregon. The white flowers give way to tile-colored fruits that persist into the winter. Its round head of bold dark-green leathery foliage turns a deep crimson.

Two comparatively unknown hawthorns, not used on American streets, are *C.*

grignonensis and *C. pinnatifida*. The latter, the Chinese bigleaf hawthorn, is outstanding. The bold oak-like foliage and magnificent clusters of large bright red berries make one wonder why this tree has been overlooked. *C. grignonensis* is a rather delicate-leaved, white-flowering tree that bears small red fruits. It is easily grown to a central leader for high clearance as a street tree.

Flowering Crabs

A number of crab apples (*Malus*) make a beautiful show on streets. Among the most suitable are 'Liset,' with bright red flowers, reddish-green foliage and shining red fruit; 'Winter Gold,' white flowers, bright yellow fruit and good green leaves; *M. arnoldiana*, pink flowers, yellow fruit; and *M. zumi calocarpa*, paler flowers and red fruit. 'Shakespeare,' a selection of *M. atrosanguinea*, has flowers that remain pink until they fall, and the fruit is inconspicuous. 'Frau Louise Dittman' is a gem with shell-pink flowers — one of the absolute best. These trees are mentioned primarily because of their flowering proclivity and the fact that they



Scanlon

The Chinese scholar-tree (*Sophora japonica*) is small enough for street planting and it blooms profusely after midsummer when in light sandy soil.

bear small pea-sized fruits that will never be a nuisance. 'Almey' and 'Aldenham' are excellent, but have slightly larger fruit than the other varieties. Crabs used for street-tree planting should never be low-headed, but rather grown as standards to provide clearance for vehicular and pedestrian traffic.

Other Flowering Trees

For August bloom, *Sophora japonica* and its pyramidal form are exceptional along streets. If planted in a light sandy soil they flower profusely in a very few years. The fallen pods, however, might prove a problem.

Another August-flowering tree is *Maackia amurensis*. The closely packed spikes of small whitish pea flowers are borne terminally. The trunk is a fine greenish-bronze color and the head nicely rounded with pleasing compound foliage.

There are other flowering trees that will be introduced to American streets in the coming years as planters become aware of the transformations these lovely trees can effect in our drab, often ugly cities. One superb tree that has lately come into use is the flowering ash (*Fraxinus ornus*), which has spicy, fragrant flowers. *Magnolia kobus*, with huge flowers, is another to be recommended. The very hardy and beautiful Japanese tree lilac (*Syringa amurensis japonica*) should not be neglected. It bears huge panicles of fragrant flowers in June and later.

The mistake of planting brittle forest giants has made an impact across the country that cries out loudly for correction. The future beauty of America will in large part be brought about through use of small ornamental flowering trees. The roadways of this beauty-hungry country demand it.

A GARDEN OF FLOWERING TREES FOR THREE SEASONS OF BLOOM

E. L. Kammerer

NOVEL as the idea may seem at first, a garden of flowering trees is not mere fantasy, but rather a practical solution to the landscape problem of providing a continuous succession of bloom over an extended period of time with a minimum of initial effort and after-care.

Space permitting, a garden of flowering trees can be just as rewarding beauty-wise, and far less demanding from a maintenance standpoint, than a garden of herbaceous perennials, annuals, roses or bulbous plants. Affording beauty overhead, at a different level than one is accustomed to looking for it, blooming in greater profusion, and in as continuous a cycle as climatic conditions permit, a tree planting such as this offers a pleasing change from the ordinary.

The number and kinds of trees one may use is dependent for the most part upon two factors, the space available and the geographical area involved. The larger the property, the greater variety possible. This does not mean that an extensive acreage is necessary for a presentable effect, for even the average-sized suburban property is large enough to support the well-balanced assortment essential to provide an uninterrupted chain of bloom. In less severe climates blossom throughout the year is possible, but in the Chicago region a succession starting in March and continuing into November would be considered maximum.

Although the flowering sequence is apt to begin on a subtle note, as the season progresses the blossoms become larger and more showy, with fragrance frequently present as an added attraction. What better subject to open the season in late March or early April than the Japanese cornel (a species of dogwood, *Cornus officinalis*), small, round-headed tree or tall shrub with peeling brown bark and full



McFarland

One of the welcome woodland flowers of spring over much of America is the shadblow (*Amelanchier*). In the home landscape this small tree also flowers early. Above is *A. laevis*.

clusters of small yellow flowers opening from plump, rounded buds. Blooming simultaneously, and serving as an interesting companion plant, is the European alder (*Alnus glutinosa*), graceful, often multi-trunked tree whose very decorative cocoa-colored catkins hang like fringe from the picturesque branches. Like the cornelian-cherry's flowers, the catkins of the alder appear before the leaves have expanded.

April Bloom

April sees a marked increase in the number of trees coming into bloom, and a greater diversity in flower shape, size



Roché

Redbud (*Cercis canadensis*) makes a good companion for the early flowers of the shad-blow.

and color. If the winter has been mild, the Ansu apricot (*Prunus armeniaca ansu*) opens its bright pink buds early in the month, producing a display rivaling the Japanese cherries. The early magnolias follow, the pyramidal-shaped anise magnolia (*M. salicifolia*) first, a week or so in advance of any of the others. Its narrow-petaled white flowers are similar in shape to those of the lower-growing star magnolia (*M. stellata*), diminutive, free-blooming species especially adaptable to small properties. Any time from mid-month on, one may look for the fragrant, cream-colored, tulip-shaped flowers of the Yulan magnolia (*M. denudata*) from Central China. Arborescent in form, and eventually reaching 30 feet or more, it is a handsome oval or round-headed tree. With it may appear the small but bright scarlet flowers of the red or swamp maple (*Acer rubrum*), the fragile, pale-pink blooms of the Japanese spring cherry (*Prunus subhirtella*), and the cupped white flowers of the Ussurian pear (*Pyrus ussuriensis*) of northeastern Asia. The latter develops into a broad, round-headed tree of medium height. At about the same time the Sargent cherry

(*Prunus sargentii*) enters the picture. This hardy species with large, single, deep pink flowers is also known for its attractive reddish-bronze-tinted new foliage.

It is near month's-end, however, before the impact of spring bloom is really felt. The Juneberries or shadblows (*Amelanchier*) are one important group whose dainty but fleeting white flowers are always an important part of the late-April, early-May picture. Ideal companions for the shadblows are the ever-dependable redbuds (*Cercis*).

May, the month of crab apples and lilacs, offers a concentration of bloom unsurpassed by any other period. With flowering crabs the major contributors, it is among them that the most usable subjects for the tree garden will be found.

Hawthorns (*Crataegus*), like the crab apples, bloom in successive waves, starting around the first of May and continuing throughout the month.

The buckeyes and horse-chestnuts (*Aesculus*) figure prominently in the May landscape, too, beginning with the flowering of the low-growing Texas buckeye (*A. arguta*), which opens its greenish-yellow flowers early in the month.

In considering subjects for May blossom we must not overlook such choice small trees as the harbinger European bird cherry (*Prunus padus commutata*), early May; the Carolina silverbell (*Halesia*), mid-May, and, where it is hardy, the lovely flowering dogwood (*Cornus florida*). Later on (late May-early June), the creamy flowers of the mountain-ashes (*Sorbus*) will have put in their appearance.

To Initiate Summer

Fringe-tree (*Chionanthus virginicus*) and yellow-wood (*Cladrastis lutea*), both natives of the South, and the tulip-tree (*Liriodendron tulipifera*), a species ranging farther northward, all collaborate in announcing the arrival of June. Of the three, the fringe-tree is the smallest in stature, actually shrubby in the North, the yellow-wood of intermediate height (to 50 feet) and the tulip-tree tall and stately (to 75 feet).

RED JADE CRAB APPLE
(*Malus* variety)

Plant Patent No. 1497. This small and gracefully irregular tree was developed at the Brooklyn Botanic Garden by the late George M. Reed. Its semi-weeping growth habit is unique. Pure white flowers open from pinkish buds before leaves appear. Small shining red fruits have great appeal after leaf-fall in autumn.



TULIP-TREE ▼
(*Liriodendron tulipifera*)

A native of the eastern U.S.A., much admired for its stately trunk and tulip-like flowers that appear in June (shown two-thirds natural size). The foliage turns clear yellow in early autumn.



GOLDENCHAIN
(*Laburnum watereri*) ▶

A tree that tends to be small, and in late spring bears gracefully suspended clusters of clear yellow flowers. Grows best in moist alkaline soil. Pods, said to be poisonous in all laburnums, seldom develop on this hybrid.



FLOWERING PEACH (*Prunus persica* varieties)

Delicate double flowers appear in early spring, before the leaves. They do not develop fruits. Deep red varieties are available, also some with purple foliage.



FLOWERING DOGWOOD ▲ (*Cornus florida*)

Native in the eastern U.S.A. and widely planted for ornamental purposes. Its floral display comes in mid-spring, before the foliage; red fruits and leaves are attractive in autumn. Horticultural varieties include trees with pink, red, and double white flowers; also weeping forms and one with variegated foliage.



SOURWOOD (*Oxydendrum arboreum*)

Late summer brings out the graceful finger-like ivory-white flower clusters, which continue their attractiveness as small pale fruits amid the brilliant scarlet foliage of autumn. A native species in the eastern U.S.A., it is the only tree member of the Heath family in our temperate climate.

FLOWERING CRAB
(*Malus*)

Abundant springtime bloom (before leaves appear) is spectacular but brief. The many horticultural varieties offer wide choice in blossom color, growth habit, and size and color of fruit. Some, when older, are of notable winter interest for their tortuous trunks.



SAUCER MAGNOLIA
(*Magnolia soulangeana*)

A chance hybrid of 1820, from a French garden, not a species as the name implies. Large flowers are dramatic in early spring before leaves appear. Several tones of rose and purple are available. Smooth gray bark and branching habit are attractive in winter.



WEeping CHERRY
(*Prunus subhirtella pendula*)

A delicate, graceful tree in every season, effective in a broad sweep of lawn. Blossoms are short-lived; there are no fruits.





HARDY SILK-TREE
(*Albizzia julibrissin rosea*)

Sometimes incorrectly called mimosa. From midsummer on, powderpuff-like flowers of lavender-pink, renewed daily, cover the wide-spreading branches of this flat-topped tree. Hardy to Massachusetts, with occasional mild injury in winter.



FRANKLINIA
(*F. alatamaha*)

This small tree, which bears its attractive camellia-like flowers in autumn, deserves to be more widely grown.

The semi-glossy foliage of franklinia turns orange-red in crisp autumn weather. Adequate soil moisture and good drainage favor its growth.

Locust blossom is typical of early June, too, not only the tall, straight-trunked black locust (*Robinia pseudoacacia*) with its drooping clusters of fragrant white blooms, but also the pink-flowered clammy locust (*Robinia viscosa*), lower-growing native of the Southeast.

Another June bloomer, without which any tree garden would be incomplete, is the sweet-bay (*Magnolia virginiana*), a glossy-leaved small tree which continues to produce a scattering of cream-colored, cup-shaped flowers sometimes until September.

The northern catalpa (*C. speciosa*), although somewhat coarse and untidy, deserves mention because of its conspicuous, two-inch creamy-white flowers in late June and early July. Borne as they are in erect, well-filled panicles, the effect is spectacular.

Flowering simultaneously, the lindens (*Tilia*) depend for interest not upon conspicuous flowers but rather on their honey-sweet fragrance. This is sufficient justification for including one specimen in the tree garden. Because Japanese tree lilac (*Syringa amurensis japonica*) is the last of the group to come into bloom, it also belongs in the planting. This small, smooth-barked tree (to 20 feet) is noted



Generous

Throughout May the hawthorns (*Crataegus*) bloom in successive waves. *C. arnoldiana* is shown here.

for its huge pyramidal heads of small, creamy-white, heavily scented flowers.

Roche



Creamy flowers of mountain-ash (*Sorbus*) signal the end of spring. One of the best to use in the home landscape is *S. alnifolia*.



McFarland
Horse-chestnut (*Aesculus hippocastanum*) dominates the landscape wherever it is planted. This is the "chestnut" of the streets of Paris. The flowers appear in May.

Although difficult to obtain, another oriental tree, the largeleaf dogwood (*Cornus macrophylla*), is an aborescent species (to 25 feet) presenting a creditable flower effect in late June. Unlike the dogwoods with large, showy bracts, this one has diminutive inflorescences in crowded, somewhat rounded cymes. Borne well above the foliage, and generously distributed, they give the entire tree a creamy-white appearance.

Late-season Flowers

By midsummer, blossoming slows down appreciably, with only a few trees left to carry on the continuity. One of these is the Chinese chestnut (*Castanea mollissima*), a blight-resistant, round-headed small tree with an unusual floral display. It is the fuzzy, cream-colored staminate (male) flowers which are the attraction, arranged as they are in narrow, cylindrical catkins 5 or 6 inches in length and extending outward from the branches at various angles. Their unpleasant odor,

Individual flowers of horse-chestnut and the leaves surrounding the cluster have a delicacy that belies the coarse appearance of the tree.

Genereux





Genereux

The castor-aralia (*Kalopanax pictus*) is one of the few trees that bloom in August. Minute white flowers are borne in large clusters at the tips of the branches.

however, relegates the tree to the back-ground.

The goldenrain-tree (*Koelreuteria paniculata*) from China, Korea and Japan, is an even more impressive ornamental reaching a climax in July. Fifteen-inch terminal panicles of small, four-petaled flowers marked at the base with an orange-maroon band, cap the tree with gold. As they age, the blossoms are shed in a golden rain. In areas where it grows well, the sourwood or sorrel-tree (*Oxydendrum arboreum*) is worthy of consideration. Flowering at the same time (late July, early August) is hardy mimosa or silk-tree (*Albizia julibrissin rosea*).

August, like July, is a month of scanty arboreal blossom, and with the exception of the floral efforts of old plants of althea or rose-of-Sharon (*Hibiscus syriacus*) which have been trained to tree form, the devil's-walking-stick or Hercules-club (*Aralia spinosa*), and the castor aralia (*Kalopanax pictus*), there is little of interest. The tiny white flowers of the prickly-stemmed aralia are borne terminally in large, showy, compound umbels. So, too, are those of the castor aralia, a full-fledged tree of bold appearance which eventually reaches 50 feet or more.

One other August-blooming tree should be mentioned, even though it is little



McFarland

Last to bloom among woody plants in northern regions is the native witch-hazel (*Hamamelis virginiana*), whose slender yellow-petaled flowers brighten woodland scenes and landscape plantings.

known and seldom seen outside of botanical collections. This is the Hupeh evodia (*Evodia hupehensis*) from Central China, a small, widespreading multiple-stemmed plant to 15 feet, with handsome compound foliage and small, ivory-colored flowers in broad, pyramidal panicles. It provides a rather showy, off-season display in mid-month.

Special for Fall

In rigorous climates, September-blossoming trees are practically non-existent. Where reliably hardy, however, the lovely franklinia (*F. alatomaha*) may well dominate the entire autumn scene. If favored by satisfactory climatic conditions, September may also be highlighted by a display of the fragile, semidouble,

pale pink blooms of the autumn Higan cherry (*Prunus subhirtella autumnalis*). Where and when it does do well, its autumn effort may equal its spring showing.

The seasonal floral cycle is brought to a colorful conclusion in October and November by the common witch-hazel (*Hamamelis virginiana*), semi-arborescent shrub to 15 feet, whose narrow-petaled, butter-yellow flowers impart a spring aspect to the autumn scene. Not large individually, they are nevertheless borne in sufficient profusion to make a creditable showing as well as to ease the transition into winter.

FRANKLINIA FROM SEED

FRANKLINIA can be easily grown from seed, according to Ida A. Thomas of Wyckoff, New Jersey, who describes her method in the *Gardeners' Forum* of the American Horticultural Society for November 1962. She gathers the capsules in December, just as they are beginning to crack, the year after flowering; the time from bloom to seed is about 15 months.

In January she sows the seeds in flats containing equal parts of lime-free loam, decayed leaf mold and sharp sand, covering them with $\frac{1}{4}$ inch of the mix. When large enough to handle, the seedlings are transplanted to 3-inch pots in similar soil. About the end of May these pots are sunk in soil in frames, covered deeply with oak leaves in fall, and with glass and an old rug for winter.

Next spring the pots are buried under a tree for the summer and kept moist. When freezing starts, a deep cover of oak leaves is worked in about the plants, now two to four feet high. Later, branches of evergreens are set among them to hold in the frost.

The following spring, the third after seed-sowing, the plants are ready for permanent quarters in full sun, protected from north winds. They will bloom in four or five years. Soil should be similar to that used for holly and azaleas. No lime or bonemeal should be used.

SOME LESSER-KNOWN FLOWERING TREES

*Redbud, goldenchain, and others with showy flowers
can also offer interesting foliage effects*

Lyle L. Bundell

NO doubt about it, the magnolias, crab apples, dogwoods and flowering cherries hold first place among the flowering trees of spring. They deserve all the recognition that has come their way. However, to stop with these, as many do, is to deprive our gardens of other fine species that are worthy in their own right. It is this secondary group that will be my theme.

Too little attention is given to the foliage effects of plants, yet the relationship of one leaf texture to another can have a marked effect on the garden. "Summer blending value," the late Peter van Melle appropriately called it. Plants of similar foliage textures blend, those of widely varying character do not. If the foliage blending is too perfect, a planting can be monotonous.

When the harmonizing of leaf textures is given no attention, the effect is likely to be spotty. Between these two extremes of monotony and too great diversity, many pleasing tree combinations can be created.

A blended area of plants all with similar character may be given punch by a strong contrast at a significant point. An interesting planting can also be made with texture varying from fine at one end to coarse at the other, without being monotonous. The plants which follow have been arranged according to leaf or leaflet size, starting with those of finest texture.

Some of the trees which are delicate when in flower appear coarse when the leaves are fully developed. Their placement in the garden thereby poses a dual problem, which, when satisfactorily solved, can give distinction to a planting in both spring and summer.



McFarland

Though seldom seen in plantings, the yellowhorn (*Xanthoceras sorbifolia*) is a tree of exceptional appeal in both foliage and flower. Branches are covered with white blooms in mid-spring.

Yellowhorn

Among the trees with fine-textured summer foliage is the little-known yellowhorn (*Xanthoceras sorbifolium*), a relative of the goldenrain-tree. Its delicate compound leaves and its upright branching habit together give it much the appearance of a mountain-ash. The terminal clusters of white, five-petaled flowers, each an inch across, are 3 to 6 inches



Roche

The fringe-tree (*Chionanthus virginicus*) is at its best when in full bloom in May or early June.

long. They develop with the leaves and when freely produced give the plant a lacy appearance.

This tree seems a rather shy, non-robust specimen—not given to taking over the landscape. It is most frequently seen in a fancier's garden where it is placed apart, for more ready apprecia-

tion of its delicate features. It should be more generally planted—if one can find it.

Black Locust

The locusts, with similarly fine foliage, can make themselves masters of any land area. As they spread readily by root



Roche

Fragile white or pink bells hang from the branches of silverbell-trees (*Halesia*). They flower about two weeks before the fringe-trees.

suckers, these plants can become pests if not kept under control.

The black locust (*Robinia pseudoacacia*) grows to considerable stature, especially in limestone soils. Where suckers have not been allowed to develop, indi-

vidual trees are often tall and sentinel-like. Their foliage is soft, thin and gray-green. Few plants are more fragrant than these when the delicate white racemes of leguminous flowers hang from all the branches.

The Goldenchains

Yellow flowers seem to intensify the warmth of the sun, so they are most welcome when they appear in early spring. The goldenchains (*Laburnum*) brighten their surroundings with long drooping racemes of pea-like golden flowers on open trees of upright growth 15 to 30 feet tall. The small stature permits use of the goldenchain in restricted areas, especially near buildings where the delicate character of its soft, deep green, clover-like leaves can be appreciated all summer.

Laburnum watereri is much the finest, with longer, brighter flowers, and perhaps a bit more robustness than its parents. It is a hybrid between the two species *L. alpinum* and *L. anagyroides*, which are less commonly available from nursery-men. A sheltered location is advisable in northern latitudes, for in winters like that of 1961-62, flower buds may be injured.

The Shadblows

The northern woodland borders of eastern North America are brightened when the amelanchiers flower. Since this occurs when shad are running to their spawning grounds, and they are common

near rivers where shad run, they have become known as shadblow or shadbush. In size they vary from low, bushy ground covers to trees of medium height. Downy shadblow (*Amelanchier canadensis*) and Allegheny shadblow (*A. laevis*), which occur as trees, are worth an afternoon's ride into the areas where they abound.

In the garden, the Allegheny shadblow is the best and should be planted more. The fine-textured foliage, which in the fall changes to yellow or sometimes red, and the bright gray bark with dark stripes, add interest. The white flowers, with petals like tissue-paper, appear just before the foliage, and the red to purple berry-like fruit ripens in late June.

The Hawthorns

Some of our most successful ornamentals are among the hawthorns, but their numbers are legion so one must select carefully. The European hawthorn (*Crataegus oxyacantha*), with foliage practically fern-like in texture, has clones with pink, red and double white flowers. But the bloom is the one recommendation. The foliage, at least along the East Coast, is inclined to blight and drop early; and it never develops rich color in autumn.

Few of our many native species are



McFarland



Genereux

Shrubs that grow also as trees: *Left, Viburnum lentago*, with rounded clusters of cream-colored flowers in early summer. *Right, the sweetleaf (Symplocos paniculata)*, an attractive plant which is only occasionally seen in northern gardens.



McFarland

A flowering branch of sweetleaf superficially resembles some plant in the Rose Family.

readily available, but two of them are outstanding. The Washington thorn (*Crataegus phaenopyrum*), a rather upright tree to 20 feet, has shiny, triangular, deeply-toothed leaves which turn a rich wine-red in fall; the flower cluster is small, creamy white, followed by clusters of small bright shiny red berries—the brightest of any fruit. If not taken by birds in the fall, this fruit will hang until spring when they return. The cockspur thorn (*Crataegus crus-galli*) spreads its spiny branches broadly until they reach the ground. The leaves are shiny and almost round. The flower clusters are large and cover the tree. Fall dividends are the rich red clusters of half-inch fruit, which may hang throughout the winter, and the richness of the deep red foliage color.

Sweetleaf

Although the Asiatic sweetleaf (*Symplocos paniculata*) is usually a large shrub, it may grow as a small tree with

an over-all resemblance to the shadblow when in flower. It is always an interesting plant, fine-textured at all times, and when the bright blue fruit is generously produced, it makes one of the most unusual displays in the garden. The birds may rob it before one has enjoyed it to the full.

Callery Pear

For the true glory of a white robe, nothing in trees quite equals the 30-foot pyramid of the Callery pear (*Pyrus calleryana*). The great clusters of white flowers, each one an inch across, completely cover the branches before the leaves appear. But the many fruits, up to an inch in diameter, are worthless: brown, tasteless and gritty. The foliage is a rich bright, shiny green of medium texture.

The Fringe-trees

The native American fringe-tree (*Chionanthus virginicus*) is, as the scientific



Gottsch-Schleisner

The empress-tree (*Paulownia tomentosa*) carries great erect trusses of lavender flowers as the leaves emerge from their buds.

name *Chionanthus* — snow flower — indicates, like a snowstorm when in flower. Multitudes of long narrow drooping petals dangle from the branch-tips before the leaves appear. The delicate flowers are followed by such coarse foliage (leaves up to 8 inches long) that placing it sometimes presents a problem. In the summer the foliage would be harmonious with rhododendrons but as it flowers about the same time it might well steal the late spring show by abundance and contrast.

The Chinese species (*Chionanthus retusus*), with exfoliating bark, is a miniature tree in comparison (sometimes a shrub). It has smaller leaves and is less

showy in flower.

In both species the two sexes are on different plants, so the dividend of dangling blue berries, with birds for a bonus, does not appear on every tree. A fringe-tree that bears both flowers and fruit is the kind of plant to use as a specimen.

Silverbell

Similar to the fringe-tree in foliage is the silverbell (*Halesia carolina*). Small white (or pink) bells clothe the rather rugged branches. The coarse oval leaves, 4 to 6 inches long, which develop as soon as the flowers are gone, belie the delicacy of the blooming season. Planted with large-leaved shrubs, the silverbell blends better than with more delicate foliage patterns.

Viburnums

The viburnums are usually shrublike, but the nannyberry (*V. lentago*) and the blackhaw (*V. prunifolium*) may attain tree stature, especially if they are pruned to a single stem. Flowers appear in white pinecushion-like tufts at the ends of the branches, along with the leaves. They are followed by decorative fruits. At first small and green, they enlarge throughout the summer and in the fall they turn from green through red to bluish black. They are especially striking when all the



McFarland

Flowers of the empress-tree (*Paulownia*).

colors can be seen at once. The medium foliage texture of the viburnums gives the plants wide adaptability, for it blends well with plants having finer as well as coarser leaves.

Dove-tree

The dove-tree (*Davidia involucrata*) has had a rather precarious existence in New England. Many specimens were killed to the ground in the bad winter of 1933, and as they came back there was only an occasional flower. But the spring of 1962 gave a display of bloom that was worth the years of waiting. It was as if a great flock of doves had landed, covering every conceivable spot on the tree. The large white flower bracts, like a dove's wings, are without doubt the greatest attraction of this tree, but its neat, bright green, coarsely-toothed, rather large leaves make this plant an excellent accent point in the garden. The dove-tree speaks the same texture language in flower and foliage.

The Redbuds

The redbud (*Cercis canadensis*) of the eastern United States is one of the choice plants of spring. Small pink or white leguminous flowers, seemingly half-opened, are thickly spread along the purplish-brown stems before the leaves. It is delightful against a background of evergreens, or the soft springtime green of larch. But when the heart-shaped leaves, 3 to 6 inches across, appear, it becomes one of the coarsest-textured of all small trees. At this time of year it does not seem at home with the evergreens, unless planted especially for emphasis and contrast.

Some persons prefer the Chinese species (*Cercis chinensis*). The foliage is similar in texture, but the plant is more vivid in flower. It is slightly less hardy than the American native.



Roche

Individual flowers of the redbud (*Cercis canadensis*) are like tiny half-opened pea blossoms.

Empress-tree

One tree that is coarse-appearing at all seasons is the empress-tree (*Paulownia tomentosa*). This is a large, fast-growing tree of open branching structure. In winter, the branches are tipped with massive heads of brown fruit capsules the size of small plums, or less massive clusters of pea-sized flower buds. When these are not winter-killed (as often happens in the North) the clusters of large purplish flowers are like bouquets of orchids on the branches. Large leaves (as broad as dinner plates), which follow, make this tree one of the boldest in any landscape. Except for a few of the larger-leaved magnolias, there are few trees coarse enough to blend successfully with the empress-tree. Its location needs to be carefully picked.



LOOK TO THE LEAVES AND FRUIT

Tree bark is an added feature of interest in some species

Harold O. Perkins



Roche

The combination of scarlet fruit and brilliant leaves in several tones of red makes the flowering dogwood (*Cornus florida*) one of the finest of autumn features in the home landscape.

FLOWERS provide the impact, but when we evaluate a tree we should look beyond the period of colorful bloom. To be selected for a high rating, a tree

should have several good features in addition to its flowers. A second, or even a third, season of distinctive interest is desirable.



McFarland photos

Hawthorns in fruit: *Left*, the Washington thorn (*Crataegus phaenopyrum*), the most brilliant of them all; *right*, the cockspur thorn (*C. crus-galli*), also with bright red fruits. Leaves of both turn orange and scarlet in the fall.

As nature dresses her gayest in the autumn, spectacular foliage colors come to many trees—but not to all of them. It is possible to select kinds with colors that suit the surrounding hues. Ornamental berries of red, orange, yellow, white, blue or black offer another rich bonus, one that is further enhanced by the flutter of birds as they enjoy their biggest feast days of the year. These fruits are generally showy for a longer period than the blossoms, sometimes prevailing for several months.

Bright-colored twigs or bark, at least on flowering trees, are not commonly seen, and by the casual viewer they are often overlooked completely. Here the beauty is more subtle and its charm is reserved for the stroller who takes time for a longer look and, with a trained eye, sees much that gives him pleasure.

Autumn Extravaganza

For vibrant autumn color among small flowering trees, the sorrel-tree (*Oxydendrum arboreum*), Callery pear (*Pyrus calleryana*), and flowering dogwood (*Cornus florida*) are a leading trio. Their dominant note is red. The first two have sparkling glossy foliage which augments the color; the dogwood has red fruits.

Leaves that vary from orange to red have a special brilliance; they seem to

catch a sunbeam and set it dancing. Korean stewartia (*S. koreana*), franklinia (*F. alata*) and Sargent cherry (*Prunus sargentii*) display the all-too-uncommon orange-to-red leaf when cool days of autumn come. None of this second trio has yet captured the interest of the American public, so it is difficult to find good specimens.

A few soft color notes make the flamboyant trees appear even more startling. The foliage of Japanese dogwood (*Cornus kousa*) and several of the hawthorns (*Crataegus*) turn a dull but pleasing red. Star magnolia (*M. stellata*) and saucer magnolia (*M. soulangeana*) remain green until late, then become a light brown, and this, combined with the thick leathery quality of the leaves, is quite attractive.

If we feel the need of sunshine when the skies are dull, we look for plants whose foliage turns a clear yellow. Yellow-wood (*Cladrastis lutea*), Carolina silverbell (*Halesia carolina*), and Allegheny shadblow (*Amelanchier laevis*) have this golden quality.

Another small tree with yellow leaves in autumn is *Parrotiopsis jacquemontiana*, but regrettably it is almost unknown in home landscapes. The dotted white bracts that surround the heads of small flowers are conspicuous among the young leaves in May.



McFarland

Individual seeds of magnolias are bright red and are suspended on slender white stalks.

Decorative fruit is something that both man and bird enjoy but in different ways. The flowering crab apples (*Malus*) lead the parade, for their fruits are rich and diverse in coloring, with yellow and red predominating, and they are commonly produced in abundance year after year. In size they range from one-quarter inch up to two inches. (Beyond this size the plant is regarded as a true apple.) Most of the fruits are very small and usually the birds devour them all before any drop to the ground.

For long-lasting reddish fruit probably nothing surpasses Washington hawthorn (*Crataegus phaenopyrum*) and Lavalle hawthorn (*C. lavallei*). Both bear a rich harvest. The former is native to this country; the latter is a hybrid between two North American species. English

hawthorns do not bear as colorful fruit, and on the double-flowered form commonly grown in the United States, Paul's scarlet hawthorn (*C. oxyacantha pauli*), fruit is rarely, if ever, produced.

Foliage of the native cockspur thorn (*Crataegus crus-galli*) also changes to orange and scarlet. After the leaves are gone the branches are still aglow with the red fruits, which remain over winter.

Like the native flowering dogwood, the Japanese dogwood (*Cornus kousa*) bears red fruits, but there the similarity ends. In contrast to the familiar tight cluster of berries, the Japanese dogwood's fruit resembles a strawberry.

The fruit of the magnolias looks at first like a bumpy cucumber. As it turns from green to pink, small sections open to display bright red seeds suspended on white semi-elastic threads.

Winter Interest

We are apt to look at the bark of a tree without really seeing it. If we would give it closer attention, we would discover attractive patterns, colors, and forms that are particularly noticeable during winter.

Korean *stewartia* and others of this genus have a smooth light-colored bark which flakes off like a sycamore's to show a variety of pale greens and tans beneath. Old trees of Japanese dogwood have the same characteristic, but since the colors are darker, the bark is less noticeable.

The smooth gray bark of the beech has several counterparts among the smaller flowering trees. Shadblow (*Amelanchier*, and yellow-wood (*Cladrastis lutea*) highlight winter landscapes with their silver-gray trunks. The star and saucer magnolias are smooth beige-gray. The Sargent cherry and Japanese tree lilac (*Syringa amurensis japonica*) are similarly smooth but dark in color. The prominent horizontal lenticels of the tree lilac make it look like a sour cherry.

On the Japanese pagoda-tree (*Sophora japonica*) it is the younger branches and twigs that provide color. They are a dark but lively green. Branches that are several years old retain this color as long as the wood is smooth.

In the Temperate Zone, especially, plants are sensitive barometers that reflect the seasonal changes. If we purchase a tree because we know of its beautiful flowers, we may as well have one with eye-appeal at other seasons too. We should ask for and expect other attributes as well: good form, summer foliage that remains crisp and tidy, and a general sturdiness—qualities that we commonly



McFarland

The silver-gray trunk of the shadblow (*Amelanchier laevis*) creates a highlight in the landscape after leaves have fallen.

assume to be part and parcel of every plant in the sales yard. But if we wish our flowering trees to give beauty beyond the springtime we have only to inquire, look, and insist.



FAMILIES OF FLOWERING TREES

A botanist explains

George H. M. Lawrence

BROADLY speaking, trees produce flowers. Exceptions are the tree ferns, ginkgo, cycads and conifers. Many have flowers that are so inconspicuous (willows, oaks, elms, hollies, most maples and most palms, for example) that they do not contribute to the importance of the tree in a designed landscape. This brief survey deals primarily with trees whose flowers are showy enough to provide a primary reason for planting them.

Trees, like all other plants, as well as animals, are grouped into families whose members possess one or more characteristics in common. For example, in the Magnolia Family the stamens and pistils are generally numerous and are spirally arranged in the center of the flower. The scientific name of a family is a Latin word. It usually ends in *aceae* (pronounced as the sounds of the letters A-C-E), and is usually derived from the name of one of its genera (plural of *genus*, one of the groups that compose a family). The name of the Magnolia Family is *Magnoliaceae*, taken from the name of the principal genus, which is *Magnolia*.

Nicety of usage directs that one refer to a family in the singular when it is given its English name, but when it is given its Latin name (whose suffix *aceae* is a plural form), a plural verb follows. Hence it is correct to say that the Magnolia Family is small, but that the *Magnoliaceae* are widespread. Another familiar genus in the family is *Liriodendron*, the tulip-tree or yellow-poplar. The anise-tree (*Illicium*), once placed in the *Magnoliaceae*, is now separated from it in a family by itself (*Illiciaceae*) because its pistils are in a single whorl and not spirally arranged.

The very large Rose Family (*Rosaceae*)—more than 115 genera and 3,000 species—is divided into six subfamilies; two are largely of trees. One of these subfamilies contains the apples and crab apples (*Malus*), pears (*Pyrus*), mountain-ash (*Sorbus*), hawthorns (*Crataegus*) and shadbush (*Amelanchier*). While some of these are grown commercially for their fruit, the showy flowers of many—often the same—species are dominant decorative features of the home landscape. An-



Roche photos

Flowers of the tulip-tree (*right*) show their relationship to the magnolia (*left*) in the spiral arrangement of their parts on a conical central structure, and by the large number of stamens.



McFarland

Flowers of the wild crab apple (*Malus coronaria*) typify the Rose Family.

other subfamily contains the stone-fruits (*Prunus*), which include the flowering cherries, plums, apricots, peaches and almonds, many of which are grown for their show of spring bloom.

The Pea Family (*Leguminosae*), known also as the Legume Family, is one of the three largest families of flowering plants (about 550 genera and more than 13,000 species). In fact, some authorities treat it as composed of three families: *Papilionaceae*, *Caesalpinjiaceae*, and *Mimosaceae*. The one characteristic said to be common to all is the type of fruit formed, the bean-like legume—but there are exceptions.

Among the *Papilionaceae* are such showy-flowered trees as the black locust (*Robinia*), yellow-wood (*Cladrastis*) and goldenchain (*Laburnum*). The *Caesalpinjiaceae* contribute the redbud (*Cercis*), the honey-locust (*Gleditsia*) and the Kentucky-coffee-tree (*Gymnocladus*) of the North Temperate Zone; also the orchid-tree (*Bauhinia*) and others of the tropics and subtropics such as the golden-shower (*Cassia*) and the royal poinciana (*Delonix*). The third family of this legume-fruited alliance, the *Mimosaceae*,

has minute flowers with many stamens in pinecushion-like heads. It is largely one of tropical regions where its members often form a dominant part of the home grounds. Here one finds the mimosas (*Acacia*) and the hardier *Albizzia*.

The Horse-chestnut Family (*Hippocastanaceae*) is small (two genera and about 25 species), but the species of *Aesculus*—horse-chestnut and the buckeyes—are renowned throughout the temperate world for the massed beauty of their floral candelabra. The family is related to the more tropical Soapberry Family (*Sapindaceae*), whose oriental goldenrain-tree (*Koeleruteria*) is prized for its pyramidal yellow trusses.

The Mallow Family (*Malvaceae*) is best known in temperate regions for its herbs and shrubs, including hollyhocks and rose-of-Sharon; in warmer regions for its trees with equally showy flowers, such as *Montezuma* and hibiscus-like Australian *Lagunaria*. Allied to it is the tropical Bombax Family (*Bombacaceae*), some members of which, including *Bombar*, produce huge showy flowers before the leaves emerge each spring.



McFarland

Flowers of black locust (*Robinia pseudo-acacia*) reveal the familiar form of the Pea Family.

The Tea Family (*Theaceae*) includes, in addition to *Camellia*, such well-known flowering trees as the loblolly-bay (*Gordonia*), *Stewartia* and *Franklinia*.

One may think of the Loosestrife Family (*Lythraceae*) as composed mainly of herbs, such as *Lythrum*, but among its trees in the queen crape-myrtle (*Lagerstroemia*) found in gardens of the tropics. (The shrubby crape-myrtle is another species of the same genus.)

In California a dominant genus of landscape trees is *Eucalyptus* of the Myrtle Family (*Myrtaceae*); there are some 300 species in the genus. Here too belong the conspicuous bottle-brush trees (*Leucadendron*).

The Heath Family (*Ericaceae*) is primarily one of shrubs, but a few kinds are trees, notably the madroño and the strawberry-tree (two species of *Arbutus*) and the sorrel-tree (*Oxydendrum*). Some species of *Rhododendron* also reach substantial size.

The Storax Family (*Styracaceae*) is noteworthy among flowering trees for the showy silverbell (*Halesia*) and snowbell (*Styrax*); the Olive Family (*Oleaceae*) for the fringe-tree (*Chionanthus*) and at least one tree lilac (*Syringa*); the Bignonia or Trumpet-vine Family (*Big-*

oniaceae) for the African-tulip-tree (*Spathodea*), the catalpas, the blue-lavender-flowered *Jacaranda*, and the yellow- and pink-flowered species of *Tabebuia*. The Chinese *Paulownia* is sometimes placed here, sometimes in the closely related Figwort Family (*Scrophulariaceae*).

Other families containing Temperate Zone plants mentioned here include the birch (*Betulaceae*), of which the alders (*Alnus*) are members. Separate male and female flowers are borne in catkins. In the Beech Family (*Fagaceae*), which contains the beeches, oaks and chestnuts, the sexes are also separate. The staminate flowers occur in spikes that, in a few species, are large enough to be decorative.

Only slightly more conspicuous are the slender-petaled flowers of the witch-hazel (*Hamamelis*) in the *Hamamelidaceae*. The sweet-gum tree is also in this family as are the shrubs *Fothergilla* and *Corylopsis*. *Parrotiopsis* is a tree genus in the group; its small flowers are set off by white bracts.

Except in *Ceanothus*, the Buckthorn Family (*Rhamnaceae*) is not known for showy bloom; but the raisin-tree (*Hovenia*) approaches this shrub group with attractive flowers. Flower parts are in either fours or fives. In *Tilia* of the Linden Family (*Tiliaceae*) the dangling clusters of five-petaled flowers are not unattractive, when they can be seen, but they are best known for their fragrance. When the stony fruits fall they are wafted by a single elongated bract attached to the stalk of the cluster.

In the Aralia Family (*Araliaceae*) there are four-inch plants (dwarf ginseng), vines (English ivy), tender shrubs like *Fatsia*, and trees like *Kalopanax*. In the genus *Aralia* alone there are herbs, shrubs and trees, some of which, like the devil's-walking-stick (*A. spinosa*), are exceedingly spiny.

At first glance, a flowering branch of *Symplocos*, the only genus in the Sweet-leaf Family (*Symplocaceae*) resembles some woody plant in the Rose Family, but the petals (frequently five, surrounding a large cluster of stamens) are united just above the ovary.

TERMS TO UNDERSTAND: "Cultivar" and "variety"

IN 1918, L. H. Bailey proposed the term cultivar to distinguish varieties originating in cultivation from botanical varieties known first from the wild.

The so-called varieties of horticulturists may be natural variants introduced to gardens from fields and forests, they may be sports or mutants arising under cultivation and propagated vegetatively; they may be selected strains of hybrids origin or pure lines grown regularly from seed. Some plantsmen have described variants originated in cultivation under Latin varietal names (such as *alba*, *grandiflora*, or *hillii*) while others have given similar variants fancy or vernacular names (such as 'Princess Elizabeth,' 'La Neige,' or 'Eva Rathke'). There is no fundamental difference between variants of garden ori-

Trees in the Trumpet-vine Family include *Catalpa*, whose flowers are shown here.

Roche



McFarland

The hollyhock-like flowers of the rose-of-Sharon (*Hibiscus syriacus*) are characteristic of the Mallow Family.

gin given Latin names and similar variants given vernacular names.

The new Code [International Code of Nomenclature for Cultivated Plants] states that in every case the cultivar name shall be enclosed by single quotation marks. It provides further that both vernacular names and those in Latin form shall begin with capital initials.

The recognition of the validity of the category of cultivar does not mean that horticulturists and plantsmen in general are going to cease talking about varieties and take up universally the more precise term of cultivar, at least not in the near future. It does mean, however, that in standard works where precision of expression is to be expected, the use of cultivar will have meaning for those who understand and use the term.

Adapted from an article by G. H. M. Lawrence in *Baileya*, Volume 1, Number 1, March 1953.



Arthur Ruhne

The Cuban pink trumpet (*Tabebuia pallida*) is one of the showiest of Florida's 150 kinds of showy flowering trees.

FLOWERING TREES IN FLORIDA

Edwin A. Menninger

FLOWERING trees in subtropical Florida provide a wonderful adventure in world travel along the garden path. Only three native trees* have conspicuous bloom, but several hundred beauties from every tropical country in the world have been introduced to brighten the landscape, and each newcomer has an individuality of its own. To scrape

acquaintance with them and try to understand their confusing moods requires re-orientation by anyone who lives in the Temperate Zone.

To begin with, flowering trees from warm countries of the earth arrange their lives quite independently of the calendar. Each tree works out a blooming schedule of its own, probably in response to atmospheric changes not perceptible to man. Flowering time does not seem to be fixed, even for one particular tree. Some

*The loblolly-bay (*Gordonia lasianthus*), the lignum vitae (*Guaiaecum officinale*), and the geiger-tree (*Cordia sebestena*).

trees may bloom two or three times a year, or, like the horseradish-tree (*Moringa oleifera*), every month from January to December, or they may refuse to bloom at all.

Homeowners, puzzled by the reticence of a special "flowering tree" that doesn't flower, often ask anxiously: "Do I need a male tree to make mine bloom?" The answer of course is no, first because both sexes are represented in the flowers of most tropical trees, and second, because a female that feels like putting on a show, can and does bloom spectacularly whether any male trees are around or not. Her flowers may not get fertilized and there will be no seed, but does she care?

In a Palm Beach garden in March 1962, a tree perhaps 30 feet high with a 40-foot spread, having three trunks, suddenly burst into profuse flowering, the whole top arising from one of the trunks smothered with scarlet blossoms. No flowers at all were produced on the rest of the tree. Inquiry proved that the tree had been planted 50 years before by a pioneer Palm Beach resident, and it had never bloomed in the memory of his daughter, who has lived all her life in its shade. The tree is a monkey-flower, or "flor de micco" (*Phyllocarpus septentrionalis*), from Guatemala, grown by the U.S. Department of Agriculture from seed collected by Dr. Wilson Popenoe about 1910. Trees were distributed all over South Florida and many of them persist.

Such monopodial blooming is not unusual in tropical trees. The mango (*Mangifera indica*) often has fruit on one branch, flowers on another, new leaves on a third. But how does one begin to understand a tree that, in Florida, waits 50 years to flower the first time, although in Guatemala it flowers when three years old?

And why bloom in March? In Guatemala the tree blooms in December. Trees that bloom in Australia in December, should bloom in Florida in June. Sometimes they do; usually they do not. There are no guideposts.

Of course most of the introduced trees in Florida are not as balky as the monkey-

flower, and plenty of them bloom exuberantly but without regularity and without reference to the weather, hot or cold, dry or wet. A gandy assortment of these exotics display their wares all through the year, and in size they range from dwarfs to giants. The colors are a rainbow on the landscape, sometimes for just a few days, again for weeks on end.

Even when both sexes are present in the flowers (as they are on the monkey-flower), many of the introduced trees growing in Florida fail to set seed, for quite a different reason. In the Temperate Zone the bee is thought of as the great pollinating agent, but in the tropics, flowers are fertilized by bats, birds, moths, butterflies, and a lot of other creatures, often of only one certain kind. Florida has plenty of insects already, yet the particular one needed to pollinate a certain flower may not yet have arrived from the flower's homeland.

Places like Singapore, Honolulu, and Cairo have such equable year-round temperatures that many flowering trees bloom more or less every month in the year, each tree responding to some individual stimulus, still undetermined, that may not affect another tree of the same kind in the same place. A teak tree (*Tectona grandis*) in my own garden in Florida developed flower buds all over the top of the tree last January, each bud as big as a pea. They remained there three months without opening, then got tired and fell off. Cold weather was not to blame. What was?

The foregoing recital of a few of the peculiarities of flowering tropical trees is a necessary prelude to a presentation of the 50 outstanding performers to be seen on the Florida landscape. The simplest way to display this floral panorama is to describe the trees briefly in a calendar arrangement. Pick the month you will be in Florida and here are the trees you will see in flower:

January

West Indian Shower (*Chamaecristula antillana*). Although a vine in its native Puerto Rico, in Florida this is a small tree that

blooms through cold weather, producing yellow flowers on the trunk as well as among the branches.

African Shower (*Cassia singuana*). Among the several hundred kinds of "shower" trees, this and *C. nicaraguensis* produce their copious yellow flowers in midwinter in Florida.

Maple Twist (*Pterospermum acerifolium*). Six-inch twisted white trumpets open at night, among dinner-plate-size leaves and persist the next day.

Hong Kong Orchid-tree (*Bauhinia blakeana*). Spectacular claret-red orchid-like blossoms, November to May.

February

Palmer's Trumpet (*Tabebuia palmeri*). Wine-red trumpet flowers appear in profusion on bare limbs, usually several times between January and March.

Geiger-tree (*Cordia sebestena*). Native of the Florida Keys, the geiger is a repeater, often blooming three times a year, without fixed schedule.

Texas Mountain-laurel or Mescal Bean (*Sophora secundiflora*). A small tree with deep blue pea flowers in clusters among evergreen leaves.

Lipstick-tree (*Bixa orellana*). Small evergreen tree with flower buds in grape-like clusters, two or three bright pink blossoms opening at a time, followed by walnut-size pods that are covered with soft prickles. The pods, usually reddish green, may also be bright orange or golden yellow, and are showier than the flowers.

March

Yellow Silk-cotton (*Cochlospermum vitifolium*). Clusters of gorgeous yellow 4-inch flowers like exaggerated hypericums at branch tips before the new leaves. A double-flowered form, with 5-inch blossoms like golden peonies, originated in Puerto Rico, grows in Florida.

Silver Trumpet (*Tabebuia argentea*). Great clusters of golden trumpet flowers cover the tree before the silver-gray leaves appear. Adopted by Sarasota and other Florida cities as their official street tree. Orlando has adopted a somewhat hardier species, *T. umbellata*.

Cuban Pink Trumpet (*Tabebuia pallida*). Like the foregoing, this covers itself repeatedly with trumpet flowers ranging in color from shell to deep pink, sometimes on a bare tree, often with the leaves. Much planted as a street tree.

Calico-tree (*Calycophyllum spruceanum*). Nearest thing to a flowering dogwood performance in the tropics is this tall Brazilian timber tree that decks itself with white bracts in great masses. A similar West Indian species (*C. candidissimum*) is equally showy in Florida.

Montezuma (*Montezuma speciosissima*). This Puerto Rican tree bears intensely red hibiscus-like flowers 6 inches across among the 8-inch heart-shaped leaves.

April

Argentine Jacaranda (*Jacaranda chelonja*). Prized in Florida over other jacarandas because it is a dwarf tree; the blue flowers are somewhat smaller and a few weeks earlier than those of its common relative.

Radermachera (*Radermachera elmeri*). This Philippine trumpet-tree produces bushel-size clusters of bright pink flowers that have yellowish throats.

Mother-of-cocoa (*Gliricidia sepium*). The



Arthur Ruhke

Maple-twist is the English name of *Pterospermum acerifolium*, a member of the Sterculia Family from India. The banana-like covering of the flowers bursts to reveal six-inch fluted white petals.



Nixon Smiley

Six-inch clusters of stamens stand erect at dusk on the bare limbs of the shaving-brush-tree (*Bombar ellipticum*).



Nixon Smiley

Spectacular vermilion flowers are set in jet-black calyces on the flame-of-the-forest (*Butea frondosa*).

common name derives from the practice in tropical countries of sticking a branch of this in the ground beside a newly planted seed of the chocolate tree (*Theobroma cacao*). The cutting roots readily, produces the shade needed. As a tree, it bears such quantities of pink or white pea flowers up and down the branches that it often resembles an old fashioned feather boa.

Hebestigma (*Hebestigma cubense*). This is much like *Gliricidia* except that it flowers with the leaves.

May

Flame-of-the-forest (*Butea frondosa*). Brilliant vermilion pea flowers are set off by jet-black velvety calyces in the clusters of bloom on this small Indian tree.

Pogonopus (*Pogonopus speciosus*). This is suggestive of our flowering dogwood (*Cornus florida*) except that the bracts are bright red instead of white.

Shaving-brush (*Bombar ellipticum*). Often miscalled *Pachira*. A green-trunked tree with great 6-inch bunches of stamens in pink, red or white festooning the bare branches.

Red Silk-cotton (*Bombar malabaricum*). An Indian giant to 100 feet with a trunk up to 6 feet in diameter, bearing 3-inch cup-shaped edible red blossoms on bare branches.

June

Royal Poinciana (*Delonix regia*). Known in most countries as "flamboyant," this big Madagascar tree swathes its branches with handsome red flowers not unlike gigantic nasturtiums. It is one of the showiest of all trees in flower.



Nixon Smiley

Fleshy red and yellow flowers six inches across emerge directly from the trunk of the cannonball-tree (*Conroutia guianensis*).



Paul Root

The Queensland umbrella-tree (*Schefflera actinophylla*) has proved to be one of the finest of plant introductions in Florida.

Cannonball-tree (*Couroupita guianensis*). A big tree bearing complicated 6-inch red flowers on special stems around the trunk. These are followed by 6-inch round seed pods, like cannonballs, that dangle on the stems for months before ripening.

Fried-egg-tree (*Oncoba spinosa*). Arabian thorny tree bearing copious white flowers with yellow centers resembling single camellias, followed by 2-inch deep brown seed-pods of golfball size.

Needle-flower (*Posoqueria latifolia*). Small tree of tropical America producing quantities of white flowers with 6-inch throats that require a special butterfly to pollinate.

July

Queensland Umbrella-tree (*Schefflera actinophylla*). Often a pot plant but outdoors in Florida a 30-foot evergreen tree, producing from the tip of each branch 3-foot plumes of red flowers, long persistent.

Queen's Crape-myrtle (*Lagerstroemia speciosa*). Like the common crape-myrtle except that this is tree-like to 50 feet or more with great 18-inch spikes of mauve flowers. One of the most spectacular of all flowering trees.

Hawaiian Tree Hibiscus (*Hibiscus tiliaceus*). A sprawling evergreen tree that in summer covers its top with bright yellow cup-shaped flowers which turn to a dark red at nightfall.

August

Jerusalem-date or Orchid-tree (*Bauhinia monandra*). The bright pink flowers with yellow margins and crimson polka dots, turn all pink the second day. The tree often blooms also in March. Despite the first common name, the tree comes from India and does not bear dates.

Tree Ixora (*Ixora macrothyrsa*). In Florida this small evergreen tree bears intensely red phlox-like flowers in 8-inch heads, long persistent.

Purple Glory-tree (*Tibouchina granulosa*). This Brazilian to 30 feet covers its evergreen foliage twice a year in Florida (March and August) with bright purple flowers, especially if allowed wet feet as in Cypress Gardens.

Portia-tree (*Thespesia populnea*). Small street tree bearing yellow hibiscus-like flowers that turn purple at night.

September

Horseradish-tree (*Moringa oleifera*). Indian tree to 30 feet with roots that do taste like the condiment. Its white flowers amid ferny foliage are reminiscent of a black locust.

Seotch-attorney (*Clusia rosea*). Strand tree to 40 feet with thick spatulate leaves as big as your hand and 4-inch flat white flowers.

Pincushion-tree (*Nauclea esculenta*). Dense evergreen African tree whose flowers, the size of tennis balls, consist of 1-inch white stamens stuck all over an interior core which becomes the seed pod.

Broom Melaleuca (*Melaleuca bracteata*). Australian tree to 40 feet with hard black trunk and small-needled evergreen foliage that makes it look like a conifer until it bursts forth with white bottlebrush flower spikes. Handsomer than the common punk-tree (*M. leucadendron*), which is overplanted in Florida.

October

Fairchild's Clerodendrum (*Clerodendrum*



Earl Dyer Ricou

The "pins" of the pincushion-tree (*Nauclea esculenta*) drop early, disclosing an edible fruit.

minahassae). David Fairchild brought this small tree from the Celebes. Its white flow-

The mountain-pear (*Carpodiptera ameliae*) of Mexico blooms in Florida but is rare there because it never sets seed. Its fragrant lavender flowers are the most spectacular of any plant in the Linden Family.

Nixon Smiley



ers are succeeded by very showy red bracts surrounding a blue seed receptacle.

Mountain-pear (*Carpodiptera ameliae*). Only two of these Mexican trees grow in Florida (both in Miami, one in a cemetery at North Miami Avenue and Northeast 17th Street, one in Chapman Field plant introduction garden) but they are so spectacular in flower that they must be included. At flowering time they are covered with 8-inch clusters of fragrant purple, 5-petaled blossoms.

Goldenrain-tree (*Koelreuteria*). Several kinds of *Koelreuteria* grow in Florida, much like those cultivated as street trees through the middle South. Some of the trees in Florida hold their leaves through the winter.

Guie Biche (*Apoplancia paniculata*). This Mexican tree is still rare in Florida, but when its spreading top is covered with dense masses of white flowers, resembling waving field of grain, it is noteworthy.

November

Colville's-glory (*Colvillea racemosa*). This Madagascar tree bears above the foliage great clusters of brilliant orange flowers that look like bunches of grapes in which each grape unfurls tiny banners of color.

Showy Chorisia (*Chorisia speciosa*). Highly spectacular, this Argentine tree covers its

bare branches with 5-inch brilliant pink, 5-petaled flowers.

Perfume-tree (*Canarium odoratum*). The deep yellow, 6-petaled flowers along the branches are not showy to the eye, but their intense, delicious odor touches the nose, and makes this the source of many perfume bases.

Dombeya (*Dombeya*). Several kinds are cultivated in Florida gardens, the commonest having upside-down, hydrangea-like clusters of pink flowers.

December

African Tulip-tree (*Spathodea campanulata*). The stunning big tulip-like vermilion flowers in head-like clusters of this Uganda tree may appear any month of the year, on different trees in different months.

Red Silk-oak (*Grevillea banksi forsteri*). The glory of Florida gardens through the cool or cold winter season is this 15-foot Australian dwarf tree with brilliant red flower spikes that resemble the clown on a jester's stick, straight out of Shakespeare.

Dwarf Poinciana (*Cassalpinia pulcherrima*). Usually bushy, but sometimes a tree, this evergreen produces fine spikes of brilliant red-and-yellow flowers; all-red or all-yellow varieties are occasionally seen. The related *C. mexicana* with spikes of yellow flowers at branch tips also blooms in winter.

Profuse white flowers cover the top of the "guie biche" (*Apoplancia paniculata*).

Earl Duer Ricou



FLOWERING TREES FOR CALIFORNIA AND HAWAII

Settlers in new regions combed the world for decorative woody plants

Albert Wilson

NATURE left Hawaii nearly bare of colorful trees, and California not much better off. Neither had anything like the big flowery blocks of the South's swamp magnolias, the crab apples of the Middle West, or the dogwoods, hawthorns and tulip-trees of the eastern United States.

After the missionaries came to the Islands, the Queen began importuning the Puritan sea captains to bring back trees to dress up her domain. From South Africa arrived the African tulip-tree (*Spathodea campanulata*) with its large bright orange-scarlet cup-shaped flowers; the blue *Jacaranda acutifolia* from Brazil, *Poinciana regia* from Madagasear, the rosy-pink shower (*Cassia javanica*) out of Java, and the gold-tree (*Tabebuia donnell-smithi*) from Paraguay. There were many others, too.

Later on, the first day Uncle Sam took over, the Forestry Department went through the canyons, climbed the mountain slopes, and spread over the flats, trying out a hundred exotics. Today, one of their eminent successes, the silk-oak (*Grevillia robusta*) from Australia, stands in forests, lighting up whole canyons with orange-red blossoms against silky gray-green leaves, and providing hardwood lumber prized by interior finishers and cabinet makers for its silky sheen. All these imports together now overpower the ever-present original yellow-flowered *Acacia koa*, and the red-flowered ohia-lehua (*Metrosideros*) which marches up and down the volcanic slopes.

California Background

Meanwhile in California, the fortune-hunters, despite all their pioneer bravery,

were homesick among strange trees—the shiny-barked madroño (*Arbutus menziesi*) and the darker-stemmed, lower-growing manzanita (*Arctostaphylos*); the foreign-looking “horse-chestnut”—the California buckeye (*Aesculus californica*), which curiously goes dormant and drops its leaves the first of June; the tall Nuttall dogwood (*Cornus nuttalli*); the grotesque yucca of the desert, and the toyon (*Heteromeles arbutifolia*) in the hills. The olive, pomegranate and mission pear, already introduced by the padres, were not enough to comfort the new settlers. So one by one magnolias came up from the South, locusts from the Allegheny mountains of Pennsylvania, catalpas out of the Mississippi valley, chestnut and linden from New England, and the decorative Osage-orange from Arkansas, Oklahoma and Texas.

Plants of every kind were brought in, regardless of climate. The Mother Lode along the Sierra foothills became a park of exotic flowering trees in pink, white, orange and lavender—the magnolia, catalpa, albizzia, paulownia or empress-tree from Japan, tree-of-heaven from China, and Washington thorn, English hawthorn, besides the orchards of apple, pear, cherry, peach, even citrus.

Golden Gate Park

The biggest importation of all was made to a most impossible site, the San Francisco sand dunes, out of which was to arise the famous Golden Gate Park. From all over the world new kinds of plants arrived. In clipper ships of the Australian trade came an unending succession of trees that were to change the aspect of the landscape: masses of golden acacia, blooming so copiously from



Wilson

Japanese privet (*Ligustrum lucidum*) as a specimen tree in California (see also page 70).

tip to base as to hide leaf, twig and branch; backgrounds of giant flowering eucalyptus to harbor under-growing rhododendrons; the Australian tea-tree (*Leptospermum*), snow white with fragrant starry blossoms; the bottle-tree (named for the shape of its trunk), with creamy blossom clusters; and the sugar-plum-tree (*Lagunaria*) with soft pink, hibiscus-like blooms from top to bottom. Then from New Zealand came *Pittosporum*, which reaches 25 feet and more with delightfully fragrant cream-colored blossoms. From Japan a rich variety was acquired: cherries, deciduous magnolias, and privet.

Colorful Foliage Added

Color in leaves became part of the scene: the Asiatic persimmon with its autumn display of red, orange and yellow foliage and its bold orange-red fruits; the ginkgo, from China, which fall transmutes to gold; Japanese maple of intense reds and coppers; and, from eastern North America, sweet-gum and oak that add a conflagration of autumn color. Even the Japanese cherry of springtime sur-

prises in the fall by coming on stage again with a rich show of bronzy leaves.

Nor did these park-builders in their taste for color neglect the greens. They knew what a back-drop could do and how one color lends value to another. So they brought in "evergreens": *Cryptomeria* from Japan, which in winter turns from grass green to such a brown that amateurs argue in anguish that it has died; *Retinospora* from Japan which turns from silvery gray-green to a delightful purple; *Cunninghamia* from China, the Chinese fir, changing from tree-green to brown.

The Lawson cypress (*Chamaecyparis lawsoniana*) is native here but has been extensively developed in England. In the variety *stewartii*, the color has been altered from blue-green to resplendent gold.

The Golden Gate Park oasis thrived and astonished the world, including California itself; and by its example of success, the gardens of the whole of California were enriched. Moreover, the world is still being explored for even more colorful trees for the area. Some of the noteworthy ones of present-day culture are described on the next three pages:

Australian Tea-tree (*Leptospermum laevigatum*). The trunk is gnarled and tapers upward; a specimen measuring 20 inches at the base may at breast height be only 8 inches in diameter. The gray color of the stringy bark blends with the gray foliage. During April and May, the star-shaped white flowers are distributed over every branch to the tip ends of the pendulous twigs. This tree may be grown as a specimen or as a hedge, either loose-growing or tightly clipped.

Black Kurrajong or Bottle-tree (*Brachychiton populneum* or *Stereulia diversifolia*). The older the kurrajong grows, the more like a long-necked champagne bottle it becomes. The shiny evergreen leaves assume many shapes on a single tree. Bell-shaped flowers of greenish-yellow, spotted brown inside, hang in clusters from the branches. The fruit pods may become so heavy that they mar the symmetry of the tree.

Catalina Ironwood (*Lyonothamnus floribundus*). Coming from Santa Cruz Island off the coast of Southern California, this member of the Rose Family adapts itself well to the climate of the West Coast. In spring it displays great flat heads of bloom like oversized clusters of Queen-Anne's-lace, on branches close to the ground and on spreading branches above. The decorative fern-like foliage serves as an excellent background for the bloom. The tree is narrow in structure and in time can reach 50 feet. The bark is stringy and reddish.

Glossy Privet (*Ligustrum lucidum*). This all-around plant is known as Japanese privet by California nurserymen. It can reach tree size and be trained as a street tree; or it may be grown as a tall hedge. In every situation the plant is handsome, especially at blooming time when every branch holds up a lilac-like cluster of cream-colored, intensely fragrant flowers. While the scent is pleasant to some, it is offensive to others. In the fall the display of the blue-green fruits is attractive both to the home owner and the birds.

Green Dracaena (*Cordyline australis* or *Dracaena australis*). Next to the palm, cordyline or dracaena, of the Lily Family, is the most tropical-looking tree in the California garden. Specimens of *Cordyline australis* will attain 30 feet, and some build up a tremendously wide base. Amateurs call the cordyline a palm, but when the plant throws out its first lily-like flowers the error in classification becomes evident. The blooms are sweetly fragrant, and occur in such large panicles that in older specimens an entire crown of leaves can be hidden behind them. The flowers are followed by blue berries; occasionally a white form will appear.

A young cordyline suggests a feather duster; all the growth is upright and the long leathery green leaves stand up rigidly. As the plant grows the lower leaves droop, creating a palm-like crown. These single-stemmed specimens will grow for many years before they put out their first flowers.



Wilson

The Australian tea-tree (*Leptospermum laevigatum*) has a trunk that is broader at the base than at the point of branching.



Wilson

Japanese privet as a street tree in Palo Alto, California.

After blooming, branching takes place, and the specimen becomes increasingly palm-like in character. The aging foliage becomes dry and leathery; the leaves are blown off, or they may be pulled. Gardeners use the tough old leaves to tie up bundles of twigs for the fireplace.

Landscape architects group cordylines, using them, for example, to cast pleasant shadow near a pool, or to subdue a harsh corner. Cordyline makes an excellent background for the agaves of Mexico or pampas grass from Argentina. Sometimes a pair will be set in front of an entrance.

Cordyline australis will grow under drought conditions, but prospers where moisture is available. It does extremely well in Coastal California, enjoying summer fogs. For the patio, young plants in large tubs often are used. And in recent years new ornamental forms have been introduced from New Zealand, some with bronze or silver stripes in the foliage.

Lemon-scented Eucalyptus (*Eucalyptus citriodora* or *E. maculata citriodora*). California is rich in eucalyptus. The trees add color to the landscape in several ways. Flowers range from soft white through cream, yellow, rose and red; some of the buds are silvery before blooms unfold, and fruit-pods may be bronze, red or copper. Color is also to be seen in eucalyptus bark, particularly the deciduous kind which strips off, reveal-

ing delightful tones of rose, purple, creamy-yellow, brown, and snow-white beneath. The deciduous lemon-scented eucalyptus has a light smooth bark, which is shed in strips periodically. It is a tree of fine appearance and pleasant fragrance.

Melaleuca or **Bottlebrush** (*Melaleuca stylphelioides*). This melaleuca grows into a tree of 40 feet, with papery, stringy bark. The leaves, gray-green in tone, are tiny, narrow and pointed. As the branches fill out they ultimately become lacy and pendulous. In bloom, the whole tree carries creamy-white bottlebrush flowers. Its size, willowiness and softness make this a conspicuous tree in any garden.

Silk-oak (*Grevillea robusta*). Silk-oaks add color to the California landscape from May till the end of July. Established trees will be aflame with orange-red bloom from mid-way to the summit of the tree.

Silk-tree (*Albizia julibrissin*). The Asiatic albizzias are much at home in California. *A. julibrissin* grows to 50 feet with a spreading crown almost as great. In deep rich soil in warm valleys this tree lights up the countryside with its cream-colored flowers. A specimen that Luther Burbank set out in



Wilson

The green dracaena (*Cordyline australis*) has many landscape uses, among them as paired specimens in entrance plantings.



Wilson

The willow pittosporum (*P. phylliracoides*) is a low-growing tree of pendulous habit, bearing fragrant yellow flowers and gold berries.

a new garden near Santa Rosa has today grown into a monument of summer beauty.

Spanish or Italian Chestnut (*Castanea sativa*). The profusely flowering Spanish or Italian chestnut may not be classed as an ornamental, for it is the nut crop that interests most who plant it. But when this round-headed tree breaks into bloom with the long tassels of cream-white flowers completely covering the foliage, it can be rightfully designated as a flowering tree. *Castanea sativa* is a handsome tree, and it is occasionally seen both as a street tree and as a garden specimen in California.

Sugar-plum-tree (*Lagunaria patersoni*). From the lowest branch to the topmost shoot, small pink hibiscus-like flowers adorn this Australian tree. With the background of gray-green foliage, they make a fine display in July. The tree, which reaches 40 feet or more, is frost-tender, but if given protection near a building, it can weather cold spells.

Sweet-shade (*Hymenosporum flavum*). This evergreen from Australia has flowers that possess a delightful and powerful fragrance. They develop in summer at the tip of every twig. The leaves are shiny; the tree reaches 60 feet in height. Recently more and more specimens have been used.

Willow Pittosporum (*Pittosporum phylliracoides*). The pittosporums are evergreen trees and shrubs of good habit. Willow pittosporum, one of the most attractive, does not exceed 20 feet in height. The young branches reach upright and then bend, falling in willow-like drapes. It is occasionally grown as a street tree but is more usual against buildings, near paths, and as background for garden pools. When the waxy yellow blooms develop, they hang singly or in clusters from the pendulous branches, and put out the delightful fragrance characteristic of the Pittosporum Family. Later there are colorful gold berries. Given plenty of water, the willow pittosporum grows into a sturdy tree with dark green leaves.

APPROXIMATE BLOOMING PERIODS OF TREES NOT IN CHART

(See Index, page 78, for references which will give the common names of species listed here.)

March-April

Acer rubrum
Alnus glutinosa
Cornus officinalis
Salix caprea

April-May

Crataegus mollis
Magnolia denudata
Magnolia salicifolia
Paulownia tomentosa
Poncirus trifoliata
Prunus armeniaca ansu
Pyrus ussuriensis
Viburnum prunifolium
Xanthoceras sorbifolium

May

Aesculus arguta
Aesculus glabra
Amelanchier canadensis
Cornus nuttalli
Crataegus lavalleyi
Crataegus pruinosa
Prunus padus commutata
Sorbus alnifolia

May-June

Chionanthus virginicus
Crataegus pinnatifida
Crataegus punctata
Davidia involuerata
Fraxinus ornus
Laburnum anagyroides
Robinia viscosa
Symplocos paniculata
Viburnum lentago

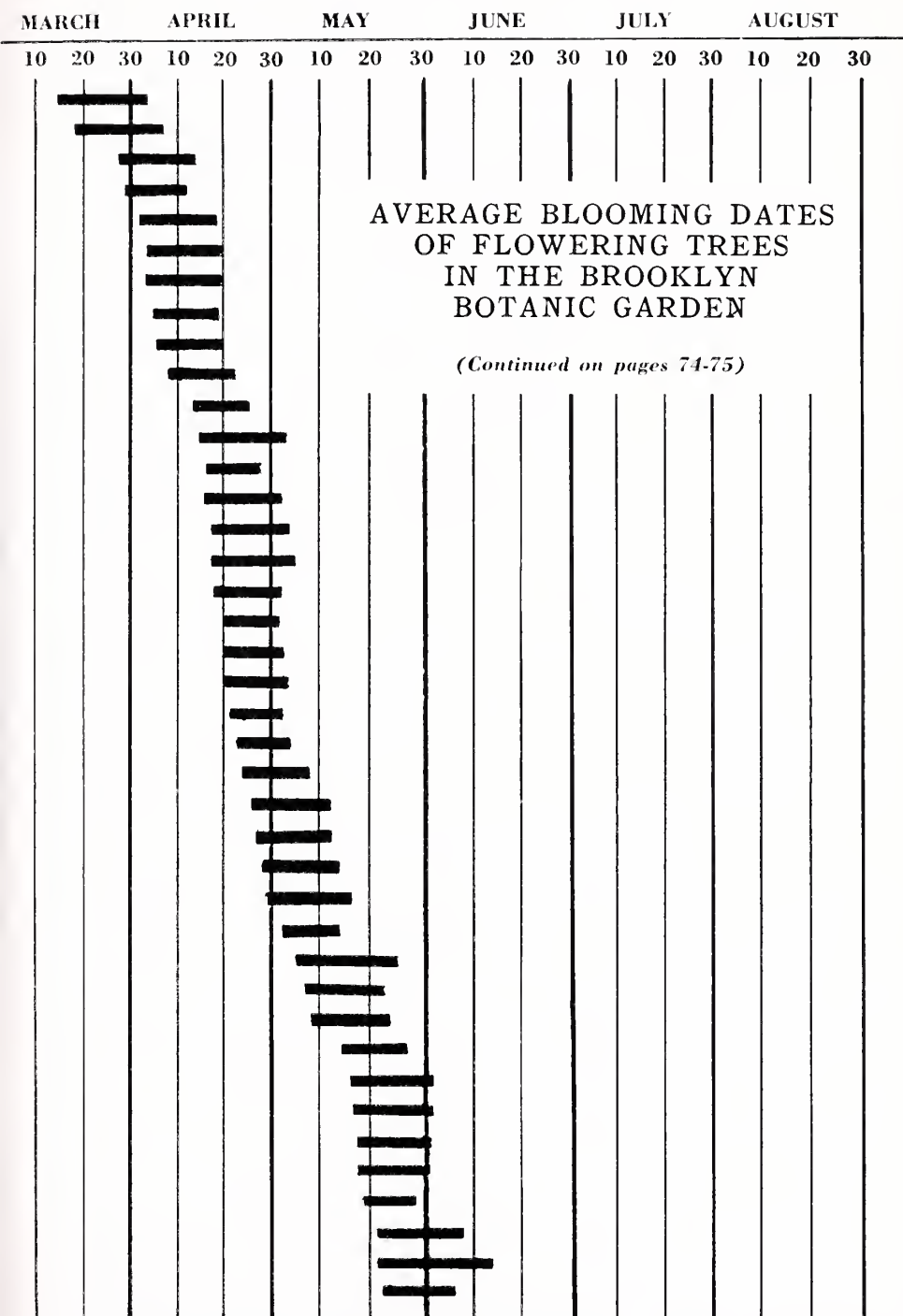
June

Catalpa speciosa
Elaeagnus angustifolia
Laburnum alpinum
Pterostyrax hispida

(Continued on page 74)

FLOWERING TREES

Red Maple (*Acer rubrum*)
Cornelian-cherry (*Cornus mas*)
Anise Magnolia (*M. salicifolia*)
Pear (*Pyrus ussuriensis*)
Star Magnolia (*M. stellata*)
Kobus Magnolia (*M. kobus*)
Higan Cherry (*Prunus subhirtella* vars.)
Yoshino Cherry (*Prunus yedoensis*)
Yulan Magnolia (*M. denudata*)
Sargent Cherry (*Prunus sargentii*)
Shadblow (*Amelanchier laevis*)
Jap. Flowering Crab (*Malus floribunda*)
Siberian Crab (*Malus baccata*)
Arnold Crab (*Malus arnoldiana*)
Tea Crab (*Malus hupehensis*)
Carmine Crab (*Malus atrosanguinea*)
Midget Crab (*Malus micromalus*)
Peach (*Prunus persica* varieties)
Redbud (*Cercis canadensis*)
Oriental Cherry (*Prunus serrulata* vars.)
Manchurian Crab (*Malus baccata mandshurica*)
Mazzard Cherry (*Prunus avium*)
Saucer Magnolia (*M. soulangeana*)
Silverbell (*Halesia carolina*)
Sargent Crab (*Malus sargentii*)
Cutleaf Crab (*Malus toringoides*)
Flowering Dogwood (*Cornus florida*)
Chokecherry (*Prunus virginiana*)
Bechtel Crab (*Malus ioensis plena*)
Red Horse-chestnut (*Aesculus carnea*)
Horse-chestnut (*Aesculus hippocastanum*)
Mountain-ash (*Sorbus aucuparia*)
English Hawthorn (*Crataegus oxyacantha*)
Umbrella Magnolia (*M. tripetala*)
Black Cherry (*Prunus serotina*)
Dogwood (*Cornus controversa*)
Black Locust (*Robinia pseudoacacia*)
Yellow-wood (*Cladrastis lutea*)
Tree Lilac (*Syringa amurensis*)
Storax (*Styrax obassia*)



NOTE: For convenience each month is represented by 30 days on this graph.

APPROXIMATE BLOOMING PERIODS OF TREES NOT IN CHART

(Continued from page 72)

June-July

Magnolia sieboldi
Stewartia koreana
Stewartia malacodendron

July-August

Cornus macrophylla
Evodia hupehensis
Kalopanax pictus
Maackia amurensis
Stewartia ovata

August

Aralia spinosa

August-September

Hibiscus syriacus

September-October

Hamamelis virginiana

Japanese Dogwood (*Cornus kousa*)_____
Japanese Snowbell (*Styrax japonica*)_____
Tulip-tree (*Liriodendron tulipifera*)_____
Cockspur Thorn (*Crataegus crus-galli*)_____
Sweet-bay Magnolia (*M. virginiana*)_____
Korean Stewartia (*S. pseudo-camellia*)_____
Washington Hawthorn (*Crataegus phaenopyrum*)_____
Catalpa (*C. bignonioides*)_____
Dogwood (*Cornus macrophylla*)_____
Chinese Chestnut (*Castanea mollissima*)_____
Large-leaved Linden (*Tilia platyphyllos*)_____
Toona-tree (*Cedrela sinensis*)_____
Rhododendron (*R. maximum*)_____
Small-leaved Linden (*Tilia cordata*)_____
White or Silver Linden (*Tilia tomentosa*)_____
Japanese Raisin-tree (*Horenia dulcis*)_____
Goldenrain-tree (*Koelreuteria paniculata*)_____
Hardy Silk-tree (*Albizia julibrissin rosea*)_____
Sourwood (*Oxydendrum arboreum*)_____
Castor Aralia (*Kalopanax pictus*)_____
Evodia (*E. danielli*)_____
Japanese Pagoda-tree (*Sophora japonica*)_____
Franklinia (*F. alatanaha*)_____
Japanese Angelica-tree (*Aralia elata*)_____

HARDY FLOWERING TREES FOR SPECIAL SITUATIONS AND PURPOSES

Partial Shade

(The more intense the shade,
the fewer the flowers)
Amelanchier (in variety)
Cercis canadensis
Cornus alternifolia
Cornus florida
Crataegus (in variety)
Halesia carolina
Magnolia glauca
Oxydendrum arboreum

Moist Soil

Alnus glutinosa
Chionanthus virginicus
Magnolia kobus
Magnolia tripetala
Magnolia virginiana
Malus (in variety)

Dry Soil

Albizia julibrissin rosea
Aralia spinosa
Crataegus (in variety)
Koelreuteria paniculata
Robinia pseudoacacia
Sophora japonica

Acid Soil

Cornus florida
Franklinia alatanaha
Oxydendrum arboreum
Stewartia species

Neutral to Alkaline Soil

Cercis canadensis
Crataegus (in variety)
Koelreuteria paniculata
Laburnum (in variety)

(Continued from page 75)

Franklinia alatamaha
Fraxinus ornus
Laburnum (in variety)
Magnolia (in variety)
Malus (in variety)
Paulownia tomentosa
Poncirus trifoliata
Prunus serrulata varieties
Pyrus calleryana
Robinia pseudoacacia
Sophora japonica
Styrax japonica
Syringa amurensis japonica

Decorative Fruit

Amelanchier (in variety)—blackish purple
Chionanthus virginicus—dark blue (on pistillate plants only)
Cornus florida—bright red
Cornus kousa—orange-red
Crataegus (most varieties)—red
Halesia carolina—light brown, four-winged
Koelreuteria paniculata—bronze
Magnolia (in variety)—red
Malus (in variety)—mostly red or yellow
Oxydendrum arboreum—pale green

Sorbus alnifolia—red and yellow
Symplocos paniculata—bright blue

Colored Foliage in Autumn

Amelanchier (in variety)—yellow to red
Chionanthus virginicus—yellow
Cladrastis lutea—yellow
Cornus florida—red
Cornus kousa—soft red
Crataegus (all except *C. oxyacantha*)—orange to deep red
Franklinia alatamaha—orange to crimson
Halesia carolina—yellow
Koelreuteria paniculata—yellow
Magnolia soulangiana—green then brown
Magnolia stellata—green then light brown
Malus sargentii—yellow
Malus tschonoskii—mixed colors
Oxydendrum arboreum—scarlet
Parrotiopsis jacquemontiana—yellow
Prunus maximowiczii—scarlet
Prunus sargentii—orange to red
Prunus serrulata—dark red
Pyrus calleryana—glossy red
Sorbus alnifolia—soft orange to scarlet
Stewartia korcania—orange-red
(Continued on inside back cover)

PLANTING AND CARE OF FLOWERING TREES

Preparation of Planting Area

Dig a hole of generous proportions, saving the good topsoil and discarding the poorer subsoil. Hole should be large enough to allow for a 6-inch space below the lower roots and a space of 6 inches beyond the spread of the roots on all sides. Loosen soil in bottom of hole.

Soil Mix

Place a mixture of two-thirds topsoil and one-third peat moss under and around the tree roots. If the peat moss is dry, first place it in a container and saturate it with water, kneading it so that water reaches every portion.

Planting Depth

Generally set a plant the same depth that prevailed in the nursery.

Planting

If the plant is a bare-root specimen, work the soil between the roots with a small pole, or, if the plant is small, shake it gently to induce soil to filter between the roots. If the plant is balled and burlapped, use caution to see that the ball of soil is not broken; after the plant has been placed in the hole loosen the burlap near the top of the soil ball and roll back the burlap to the sides, but do not attempt to remove it. Firm the soil around the plant to eliminate large air spaces and to help hold the plant in place.

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PLANTING AND CARE OF FLOWERING TREES

(Continued from page 76)

Staking

Trees that are more than one inch in diameter need to be staked to keep them from swaying and thus exposing the roots to the air. Trees more than two inches in diameter should have a double stake. Protect the trunk from rubbing or girdling by having any guy wire or rope pass through a section of rubber hose placed around the trunk. Remove guys after the second year.

Watering

Thoroughly water at time of planting, using enough to soak the lower roots. Water once a week during the first two years unless there is ample rainfall. To make sure that water reaches the lower roots it is well to use a "soaker"—laid on the ground above the tree's roots—or a perforated metal rod attached to a hose, which will get the water more quickly to the root level.

Extra Precautions

A layer of leaf mold or other mulch placed on the surface over the root area helps to conserve moisture. If it is higher at the perimeter it will act as a basin to help hold water.

Newly planted trees two inches or more in diameter should have the trunk wrapped to the first major side branches; use a special tree-wrap paper that comes in rolls three inches wide.

Remove all wired labels; these will cause girdling as the tree grows.

Fertilizing

Any fertilizer that is applied at planting time should be in small quantities and be of a mild organic type. After the tree is established use a fertilizer high in nitrogen such as 10-6-4. Trees require fertilizing after the second year more than at time of planting. If a tree is in a sod area it is well to make holes with a punch bar to get the fertilizer below the grass-root level. Place the holes a foot apart and water the area well after fertilizing. Feed trees only in early spring.

Pruning

Nursery-grown trees with a compact root system require little pruning at time of planting; this is particularly true of plants moved with a ball of soil. If many roots have been lost in transplanting, cut out some of the smaller branches to reduce the leaf surface. By the second year, trees can have some pruning done in late winter. Remove branches that as they grow would tend to rub another branch, and head back any branches that tend to spoil the shape of the tree. If two branches of equal size are forming a double leader, cut one back a third or remove it entirely. In making a cut, prune to a bud, to a side branch or flush with the trunk; do not leave stubs. Wounds over a half-inch in diameter should be treated with tree paint.

Insect and Disease Control

Spraying may be necessary to control various pests. Since these vary with species and may be of regional nature, it is well to consult a reference book or your county agricultural agent for specific control measures.

—HAROLD O. PERKINS

INDEX TO FLOWERING TREES

The common, botanical and varietal names of all flowering trees mentioned in this Handbook are indexed here. The botanical names are in *italics*. Trees shown in illustrations are listed by botanical name only, the page numbers being given in **boldface** type after the references to text pages. The word "color" refers to the four-page color insert between pages 40 and 41.

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(Continued from page 76)

Colorful Bark

- Amelanchier* species—gray, dark-striped
Cladrastis lutea—gray
Cornus kousa—mottled tan and green
Cornus officinalis—brown, peeling
Maackia amurensis—greenish bronze
Magnolia acuminata—cinnamon-brown
Magnolia sauranseana—beige-gray
Magnolia stellata—beige-gray
Poncirus trifoliata—green
Prunus maackii—golden brown
Sophora japonica—green (1- to 4-year-old branches)
Sorbus alnifolia—gray
Stewartia korcania—mottled light tan and green
Syringa amurensis japonica—reddish brown

An authoritative color map showing zones of hardiness for plants is available (15 cents) from the Superintendent of Documents, Washington 25, D. C. (Prepared by Henry T. Skinner, Director of the National Arboretum, and a committee of the American Horticultural Society.)

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PLANTS & GARDENS

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SUMMER
1963

Greenhouses
of All Types

How to Run Them

Plants to Grow
and at What
Temperature

When to
Start Them

When They Bloom

NEW SERIES

VOL. 19

NO. 2



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PLANTS & GARDENS

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Courtesy of Lord & Burnham

A free-standing greenhouse in partial shade.

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Summer 1963

For decades the Botanic Garden Staff has been answering questions about plants and how to grow them. Roughly ten thousand such questions come in each year over the telephone, and about as many by letter. It is quite a job, and requires an always patient and always courteous operator—whose lines are tied up during the question hours like plaques are stacked over an airport of an extra-busy day.

As the years go along, we are having an increasing number of queries from owners of home greenhouses, or those who are planning to build. Their problems are multiplying about in proportion to the increasing interest in the ever-fascinating subject of growing plants under glass during the winter season. To better answer the questions and help lighten the load of daily inquiries, we invited Mr. James U. Crockett to be Guest Editor of a Handbook on this subject. He invited a group of knowledgeable authors to write on every phase of it that is likely to interest the amateur grower, and the 94 pages that follow are the fruit of more than a year's effort of choosing the subject matter, selecting, compiling, editing and illustrating. More than 100 pictures are included.

This greenhouse handbook for the amateur will provide helpful guidance to the experienced as well as the inexperienced grower. The guides (pages 22 and 23) tell when to start things—and when they bloom. The hints for new greenhouse owners (page 24) are from the pen of our beloved Alys Sutcliffe, and represent a lifetime of careful observation. If an inexpensive plastic greenhouse would answer the growing urge for one or a few years (page 10), it is worth building. But if in a windy climate where limbs blow out of the trees in winter, it might pay to protect the plastic skin with a sheathing of fine mesh chicken wire—or other suitable protection.

Perhaps a sun-heated pit greenhouse will have appeal (page 18); or, a partially heated lean-to may be the answer to your needs (page 79). In either case, the information is all here. Moreover, there are 14 special articles on the plants—or groups of plants, to grow under glass. To satisfy his personal whims and horticultural urge, every man will make his own choice of plants. One might just remember, incidentally, that the Greeks and Romans found winter culture of plants an interesting idea, too (page 81), but greenhouse construction as we know it had to wait for the manufacture of sheet glass—a short two hundred years ago.

Sincerely yours,



Director

CHOOSING A HOME GREENHOUSE

Units are made in many styles that are easily put together

James Underwood Crockett

THE greenhouse most familiar to home gardeners is the standard type, made of glass with either a metal or wooden frame. It can be a beautiful structure, and it has stood the test of time by giving years of trouble-free service.

Different Types of Structure

Plastic-covered greenhouses have advantages of their own; these include simplicity of assemblage and initial economy. Pit greenhouses, which require little or no internal heating, have their usefulness for plants that tolerate or demand low temperatures. Both these types are treated elsewhere in this Handbook. A sort of miniature greenhouse is the English cloche, which covers individual plants or rows of plants outdoors in early spring when frost damage is still imminent. Here

our subject is the glassed-in greenhouse in its various forms.

Free-standing or Lean-to

Greenhouse manufacturers offer two types of structures for home gardeners, the free-standing greenhouse and the lean-to. Each of these is available in two styles, one with the greenhouse built atop a masonry or wooden wall, and the other with glass sides all the way to the ground. Generally speaking, either will serve the home gardener well, but manufacturers suggest that in areas of extreme cold and deep snow, there be a solid wall of some sort for a foot or two above the soil. This is consistent with commercial greenhouse practice.

The greenhouse you select should suit your particular needs of architecture,



Free

A free-standing greenhouse with glass on three sides, unattached to any other major structure, and with a shed at the far end which contains the heating unit and also serves as storeroom and workroom.

site, exposure and size. It is not a matter for hasty decision. Consult various catalogs and visit other gardeners who have greenhouses. Any greenhouse you select will soon be filled to capacity and you will wish you had purchased a larger one. So plan to get a structure large enough to satisfy your foreseeable needs. While sections may be added to home greenhouses as time goes on, costs are less if the whole job can be done at one time. Moreover, in a large greenhouse plants are likely to grow better and be easier to care for than in a tiny one.

Erecting One's Own

Modern hobby greenhouses are designed to be erected by do-it-yourself gardeners with little more than a screwdriver, wrench and level. Simple plans and number-matched parts make the job proceed swiftly and without error. All parts, including glass, are pre-cut and made to fit so well that any handyman can put them together without trouble.



Many people construct their own greenhouses from standard units available from greenhouse manufacturers.

This mass production and standardization of parts has lowered manufacturing costs so that hobby greenhouses today are financially feasible for nearly any flower-lover. Several companies offer them (see list of manufacturers, page 9), and each has styles available to suit nearly any situation.



Courtesy of Lord & Burnham

A lean-to greenhouse has the advantages of heat from the house and accessibility in all weather. There should be an outside door as well as one into the house. The south or southeast side of the house offers the best location.



Courtesy of National Greenhouse Co.

This greenhouse, measuring 15 by 17 feet, is equipped with a wide center bench. Note heating unit at far end, and thermostatic control unit at left.

Professional Aid

Greenhouse manufacturers say that many of their customers ask for what appear to be minor changes in the stock plans. These can add considerably to construction costs. A discussion with a greenhouse representative, or a bit of correspondence with a company, may turn up methods of using standard sizes not thought of by the home-owner. Professional assistance is free and is based on years of experience in solving problems of this nature. If at all possible, one should choose a greenhouse of standard size and shape.

In no other segment of greenhouse construction is professional assistance more valuable than in the design. While the do-it-yourself builder can do a workmanlike job of setting up a prefabricated home greenhouse, his ideas of design are not apt to be as practical as those of the greenhouse engineers whose training and experience equip them for this specialized work. In other words, do not try to build a greenhouse completely on your

own; the professional models will grow plants better and at less total cost.

Construction Materials

Greenhouses must be designed to take the greatest possible advantage of the sun's rays during the short days of winter. In addition, they must be constructed of material which will neither warp nor rot away. They must be built with enough strength to resist high winds and heavy snow loads, yet structural supports must be of such slight dimensions that they will not unduly hinder the passage of light.

For many years, cypress and heart redwood had few competitors as greenhouse construction materials. Both woods are light in weight, knot-free, relatively inexpensive, and highly resistant to decay. They do, however, require periodic painting, a costly and time-consuming task. Therefore, one sees an increasing trend toward all-aluminum frames for home greenhouses, though the advantages of wood will always assure it of a goodly share of the market.

The professionally made wooden framework is ingeniously designed to carry off condensation which accumulates in high humidity. This one fact alone should convince any would-be greenhouse owner that it is better to buy from a greenhouse manufacturer rather than a local lumber yard.

Orientation and Exposure

If you have a spot that gets at least three hours of winter sunlight daily, you can have a home greenhouse. In such a location you could not expect to grow as great a variety of plants as if you had full sun all day, but your greenhouse will still be very much worth while. The best exposure is south or southeast; a western exposure will do well, but it is often a bit harder to heat in the winter and somewhat hotter during the summer. Greenhouse experts say that the ideal orientation for a freestanding greenhouse is east and west, but home gardeners will have fun with their greenhouses whatever the compass reads.

Special Considerations

Temperatures. Greenhouse plants can be divided into two general categories as far as their temperature needs are con-



Courtesy of Lord & Burnham

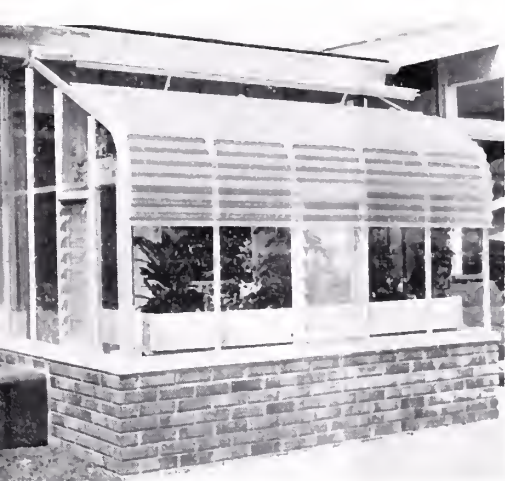
A small attached greenhouse.

cerned. Either a grower decides at the start that he will have only warm- or coolhouse plants, or he devises some scheme for handling both kinds. Ideally, a home greenhouse is divided by a glass partition into two sections to accommodate the needs of different species. True, warmth-seeking plants can be placed close to the heat and cool-growing species can be given the coolest part of the greenhouse, yet, a zoned greenhouse is the final answer to the problem. One zone with a 40°-50°F. night temperature and another with a 60°-65°F. night temperature will do the job nicely.

Foundation. Greenhouses are sold without foundations since these can be built more economically by a local contractor than by the greenhouse manufacturer. In any event, do not build the foundation until you have exact plans; the manufacturer will send them to you in advance of the delivery of the greenhouse itself if you will ask for them.

Doors. Greenhouses should have an outside door so that soil, pots, fertilizers, and plants can be transferred easily without the necessity of carrying them through the living room, for example. An inside door, in addition, will give ready access from the house.

Heating. The method by which you heat your greenhouse should be the sub-



Courtesy of Aluminum Greenhouses, Inc.

Green shading of fiberglass is used on this small lean-to greenhouse in summer. The top ventilator is the traditional type; side ventilation is provided by jalousies.



Courtesy of Lord & Burnham

A window greenhouse. Ready-made units are available to fit windows of standard size.

ject of earnest discussion with your greenhouse representative. Perhaps the least expensive way is to connect with your present home heating system, but this is not always possible. Special greenhouse heaters that use gas, oil or electricity may be used, and each will fit some situations better than others. At this point, lean on an expert's advice.

Ventilation. The problem of ventilation is of importance, for unless fresh, cool air is provided during hot days your plants can "cook" nearly as effectively in a closed greenhouse as in a pressure cooker. Automatic ventilation is the only practical solution. The cost is not great, yet it is one of the most vital

prerequisites of carefree greenhouse gardening. It gives peace of mind along with good cultural effects.

Cost

It is at this point in the discussion of home greenhouses that the uninformed express their fears that private greenhouses are still for the wealthy. Today's greenhouses are not expensive. First-rate equipment for a pair of skiers, a small boat, or even a boat motor often costs more than a modest greenhouse.

To be specific, one leading company offers an all-aluminum lean-to greenhouse, 7 feet wide and 8½ feet long, delivered, for \$280. A second firm lists a beautiful all-aluminum lean-to 10 feet wide and 12½ feet long for \$436. Another sug-

gests a freestanding model 15 feet 4 inches wide and 17 feet long for about \$780, including greenhouse benches. Fancier models cost somewhat more. Heating, foundation, and automatic ventilation costs are not included in greenhouse prices.

The uninitiated are also needlessly frightened by the heating costs. Here are a few sample yearly heating costs determined by a national magazine survey: cool greenhouse, 14 by 18 feet, Massachusetts, \$75; warm greenhouse, 10 by 15 feet, Alabama, \$30; warm greenhouse, 12 by 16 feet, Maryland, \$60; and a warm greenhouse 16 by 27 feet, Colorado, \$50.

There are many greenhouses on the market which will satisfy the desires of the most exacting flower-lover. Part of the fun is in deciding upon the model best suited to one's desires. Compare the catalogs, the quality, the availability of service, the reputation of the manufacturers, and the cost. You are apt to find your home greenhouse to be your most gratifying investment in gardening.

Window Greenhouses

If a full-size greenhouse is out of the question for one or another reason, a window greenhouse offers a splendid opportunity to enjoy many greenhouse benefits in a limited space and at a minimum of expense. It is like an extension of bay-window culture. Even more light and ventilation are available.

Modern window greenhouses are made of aluminum and glass, and will last indefinitely without upkeep. They are manufactured in dozens of sizes to fit standard windows, and manufacturers will even custom-build window greenhouses to fit special locations. They can be easily installed over outside window frames with a few hand tools. Delivered prices begin at less than \$75.

Perhaps the only caution that should be given to potential buyers of window greenhouses is this: Be prepared to graduate to a full-size greenhouse, once you have tasted the pleasures of gardening under glass!



Greenhouse Manufacturers

Listed here, in alphabetical order, are the principal manufacturers of home, or hobby, greenhouses in the United States.

Aluminum Greenhouses, Inc., 14615 Lorain Avenue, Cleveland 11, Ohio

Janco Greenhouses, J. A. Nearing Company, 4229 Bladensburg Road, Brentwood, Maryland

Lord & Burnham, Irvington-on-Hudson, New York

Metropolitan Greenhouse Manufacturing Corporation, 1815 Flushing Avenue, Brooklyn 37, New York

National Greenhouse Company, Pana, Illinois

Pacific Coast Greenhouse Manufacturing

Company, 650 Bayshore Highway, Redwood City, California

Redfern's Prefab Greenhouse Manufacturing Company, 3248 Los Gatos, Highway 17, Santa Cruz, California

Stearns Greenhouses, 98 Taylor Street, Neponset, Boston 22, Massachusetts

Sturdbuilt Greenhouses, 11304 S. W. Boones Ferry Road, Portland, Oregon

Texas Greenhouse Company, 1500 West Rosedale Street, Fort Worth 4, Texas

Turner Greenhouses, P. O. Box 1260, Goldsboro, North Carolina



This 10 by 16-foot plastic greenhouse can be constructed for about \$300.

A PLASTIC GREENHOUSE

Low in cost and simple to construct

P. H. Massey, Jr.

PLASTIC greenhouses have been the subject of an active research project at Virginia Polytechnic Institute since 1954, and plans for building commercial-size greenhouses have been available since 1955. The demand for a smaller, more attractive, reasonably priced greenhouse suitable for the home grounds has prompted the V.P.I. research team to develop a home-size structure.* The greenhouse designed to meet this need measures 10 by 16 feet, and costs less than \$300 to build.

Easy to Erect

The structure has a Gothic shape. The ribs or rafters are made of lath strips and spacer blocks which are glued and nailed together inside a jig that determines their shape. A simple pattern for building both the jig and the rafters is available with plans for building this greenhouse. Erection is simple. The ribs, which are spaced 48 inches from center to center, can be bolted to short posts or to a cinder-block foundation at the bottom. The top ends of the ribs are fastened to the ridge board.

The use of diagonal braces through the spacer openings in the ribs provides a clear span structure. The resulting unobstructed

interior wall area facilitates the application of an inner lining of polyethylene plastic.

Covering

The covering material for the greenhouse can be plastic or fiberglass, depending on the wishes of the builder. Weatherable polyethylene plastic film, 4 mils in thickness (one two hundred fiftieth of an inch), is the least expensive satisfactory covering material. Sufficient plastic of this type may be purchased for less than \$20.

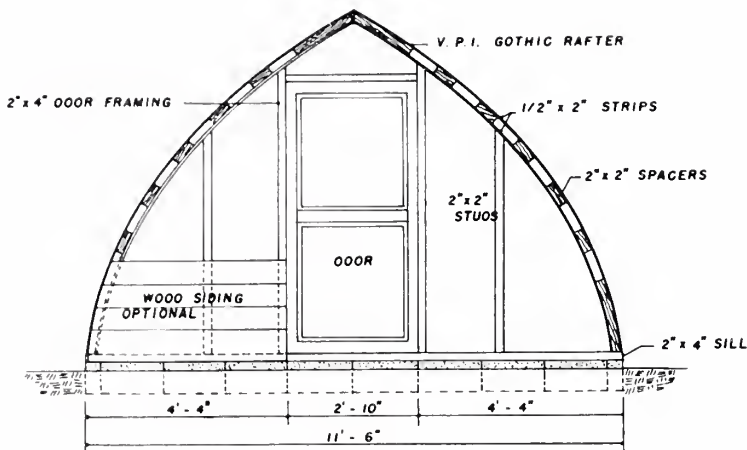
If a more permanent covering is desired, fiberglass may be used. The greenhouse pictured is covered with clear fiberglass weighing 1½ ounces per square foot. This covering material would cost retail about \$140.

Research at Virginia Polytechnic Institute and Cornell University has demonstrated that a second layer of plastic film, as an inner liner, reduces the heat loss by approximately one third. This inner lining of plastic can be paid for in a short time by savings on fuel consumption and is a good safety factor in the event of a rupturing of the outside layer of film.

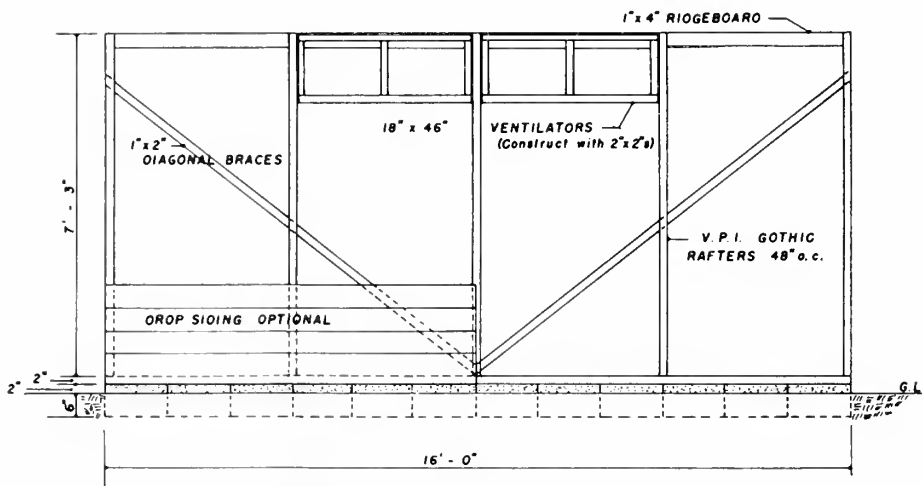
Heating

If the greenhouse is located near the residence, the structure may be heated by running a pipe or duct from the house.

*Complete plans for the home-type plastic greenhouse described here are available without charge from Virginia Polytechnic Institute, Blacksburg, Virginia.

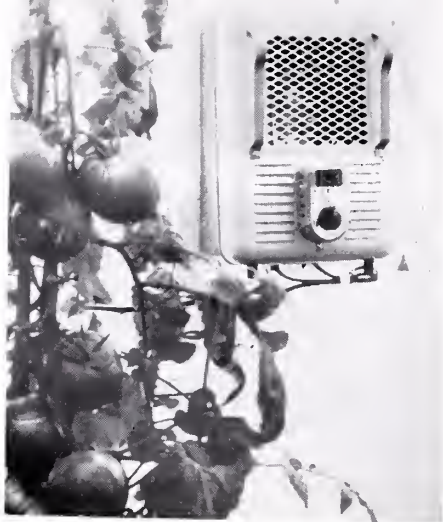


FRONT ELEVATION



SIDE ELEVATION

Basic plan for the greenhouse illustrated opposite. Planting can be done directly in the ground in this no-bench structure. There is adequate headroom.



Four electric heaters like this one, with fans and thermostats, are adequate for heating the 10 by 16-foot plastic greenhouse over winter in the climate of Blacksburg, Va. (Zone 7).

Otherwise small heaters that use gas, electricity, oil or coal can be considered. The kind selected will depend on the purpose or use of the greenhouse, climatic conditions expected, and the cost and availability of fuel.

At V. P. I. a furnace with an output of 20,000 B.t.u. per hour provided adequate heat in a double-layered plastic greenhouse. A heating system of this capacity maintained a 60°F. temperature differential between inside and outside the greenhouse. For example, the furnace maintained a temperature of 70°F. inside the structure when the outside temperature was 10°F. This is adequate for most plants.

Circulation of the heated air in the green-

house is essential. Poor plant growth usually results from uneven heat and air distribution. Therefore, the heating system should have a fan or fans to force the warm air uniformly throughout the structure.

Ventilating

A forced ventilation system is not essential for early spring use of the greenhouse. But at any season, when the sun shines brightly or when the weather is warm, it is difficult to maintain desirable greenhouse temperatures. An automatic system will relieve the operator from having to make constant checks on the inside temperature.

An automatic ventilating system can be installed in the greenhouse in place of the top ventilators. An exhaust fan sufficient to exchange the air once every minute is located in one end of the structure and connected to an air-switch-type thermostat. In the opposite end, either in the door or wall, a gravity-operated louvre should be installed which will open to let in air when the fan is in operation. Such a system prevents overheating of the greenhouse when no one is in attendance.

Uses

These small semipermanent greenhouses offer gardeners an opportunity to extend their gardening enjoyment through the entire year. Excellent flowers and vegetables can be started for the outdoor garden or grown to maturity in a home-constructed plastic greenhouse. In fact, with good heating and ventilating systems installed, almost any plant can be satisfactorily grown under plastic.

Chrysanthemum flowering time in the plastic greenhouse.



GREENHOUSE OPERATION

It is important to understand the essentials

Harold E. Gray

TWO big questions in the mind of almost everyone contemplating greenhouse gardening as a hobby are how much time is required for care and how much ability is needed to succeed in growing the plants desired. Neither of these factors should stand in the way of a real desire for a pleasant and gratifying hobby. The time required for care and operation has been reduced to a minimum through the numerous mechanical and automatic devices that perform many of the daily operations. Successful culture can be realized by starting out with familiar and easy-to-care-for plants, following a few simple rules, and then, through the experience gained, working toward some of the more unusual species.

The five basic essentials of plant growth are warmth, air, water, light and nutrition. These can all be easily provided for plants in a greenhouse. When they are properly handled, success is readily attained. Closely allied with these essentials is the control of diseases and insects. If this is achieved, there should be few remaining problems.

Temperature and Ventilation

Plants differ in their temperature requirements and even a single plant may vary in its needs during different periods of growth. It is common practice to refer to a greenhouse temperature as that which is maintained during the night. A higher one is maintained during the day, which is the more active growing period of the plant. On dull days the thermometer may read about five degrees higher than at night; on bright sunny days, from ten to fifteen degrees higher.

Plants may be broadly classed as cool greenhouse crops grown at 45 to 50 degrees night temperature and moderate to warm greenhouse crops grown at 55 to 65 degrees. In the former category are such

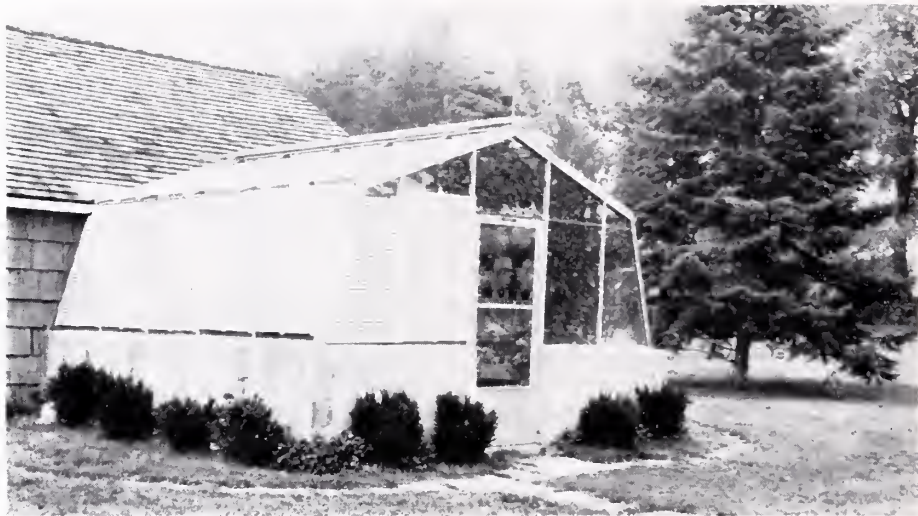


The thermostat should be placed away from direct sun, or shaded, as here.

well-known flowering plants as carnations, irises, geraniums, primroses, snapdragons and sweet peas. Warmer crops are begonias, chrysanthemums, petunias, orchids, gardenias and zinnias.

Control of the temperature is fairly simple with the automatic heating systems that are available. Keeping the temperature as low as possible, as long as it is within the limits of the requirements of the plants, will save on heating costs. The heating system should be under the control of a simple yet reliable thermostat, such as the one illustrated. This model can be used either as a heating thermostat or as a control for cooling equipment or ventilators. A sunshade is important to prevent direct rays of the sun from affecting the operation. Face

(Photographs by courtesy of Lord & Burnham)



Fixed slat shading in place to protect greenhouse plants from summer heat.

the open side of the shade away from the sun.

Summer control of temperature is a bit more difficult because of the heat produced by bright sunshine. However, much of the sunlight can be intercepted by shading. Commercial growers, who are not concerned with appearance, paint a shading compound on the glass. Such material is unsightly on the home greenhouse—slat shading is far better in appearance. Fixed slat shading, as shown in the illustration, can be applied in late spring or early summer and removed and stored in fall. However, more flexibility can be had with the roll-up type of slat shade, also pictured. Even in summer there are many dull days when it is desirable to remove the shades for light if not for temperature. Ropes make the roll-up shades easy to manipulate from the ground. Newer materials being used for roll-up shades are colored screening made of Fiberglas or Saran. These are quite durable, somewhat cheaper than wood, and they function similarly.

Summer cooling is also helped by providing ventilation. Today many greenhouses, such as the one on the opposite page (top), are equipped with sash in the roof which permit the warm green-

house air to flow out. These sash can be provided with motorized operators controlled by thermostat to open the vents automatically and thus free the gardener of the care and worry of this chore. Opening must be provided for the cooler incoming air. The door can serve such a purpose or the greenhouse can be provided with side sash openings (see illustration, page 4).

A recent development, gaining in popularity because of its excellent performance, is evaporative cooling. In this the outside air is drawn continuously through wet pads by a fan. In passing through the pads, the air picks up water and evaporates it—a process which cools the air. A compact self-contained unit for evaporative cooling, automatically controlled by a thermostat such as is illustrated here, can be mounted outside the greenhouse.

Even with the best means of control, the temperature may vary inside the greenhouse. This should not be a cause for concern—instead it can be used to advantage. The warmer spots may be used for warmhouse crops and the cooler areas for coolhouse crops, thereby permitting the growth of both kinds all in the same greenhouse. Shelves to extend



Roll-up type slat shading can be lowered as needed in summer sunlight. Ventilators along the ridge are shown in open position.

the growing space in the greenhouse can at the same time raise the plants to a higher level where the temperature is likely to be higher in the summer. In winter, however, this area close to the glass may be cooler. Through experience the gardener can learn where these variations occur in his greenhouse throughout the year and use them to considerable advantage.

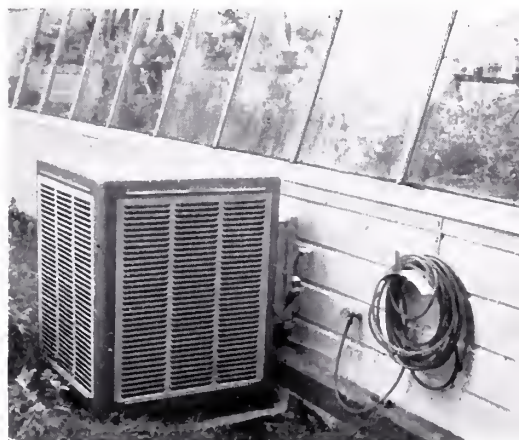
Greenhouse Water

Water in the greenhouse is in two forms—that which is in the soil to be taken up by plant roots and that which is in the air in the form of humidity. Watering is not a complicated operation and yet if not performed properly can lead to numerous difficulties. The primary aim in watering greenhouse plants is to moisten the soil without wetting the foliage. Excessive wetting of the foliage and the splashing of water from the soil surface up onto the foliage can lead to the encouragement and spread of many leaf-borne diseases.

Numerous methods have been devised to maintain the soil in a satisfactorily

moist condition and at the same time to reduce the labor for the gardener. Primarily these methods of watering fall into two broad general classes: overhead watering—that is, applying water to the surface of the soil—and subsurface irrigation.

The simplest method of subsurface irrigation for the home gardener is wick



An evaporative cooling system, installed outside, continuously draws air through wet pads to the interior of the greenhouse.

watering. Individual pots or flats are fitted with wicks extending down through the bottom of the containers and hanging in a reservoir of water underneath. The water then moves up the absorbent wick from the reservoir and in turn up through the soil by capillary action. The moisture content of the soil is governed by the distance from the surface of the water to the surface of the soil. This distance should not be more than 8 inches; for seed-pans and flats a 4-inch distance produces best results. In using this method of watering there is a chance of salt accumulation at the surface of the soil because the water moves upward and evaporates at the surface. Consequently an occasional surface watering is desirable, but a great portion of the labor involved in watering is eliminated.

One way to reduce labor in surface watering is by the use of nozzles inserted in hose or pipe around the edges of the bench. The spray is flat enough that it covers the surface of the soil evenly, yet splashes very little water on the foliage. This method permits the watering of an entire bench at one time by simply turning on a single valve. By replacing the hand valve with an electric solenoid valve controlled by a time clock, the method can be made almost completely automatic.

Timing of surface watering is important to successful growth of plants. More frequent watering is required in coarse loose soils than in dense compact soils, yet the former are desirable for good plant growth because of the aeration provided for the roots. More frequent watering is required on warm bright days in the summer than on dull or cooler days. To determine the time for watering, dig into the soil all the way to the bottom of the bench. If the soil is dry, apply sufficient moisture to wet it thoroughly.

Most successful gardeners prefer morning watering when the temperature is rising and the long period of evaporation is beginning. Watering in the evening is an invitation to trouble because of the possibility of excessive humidity and con-

densation on the foliage. Applying cold water during the watering can shock the plants. Many greenhouse owners run a hot water line into the greenhouse as well as a cold water line. Both lines should be run to a mixing valve which can be adjusted so that lukewarm water can be used in watering.

Control of Light for Plants

Light is essential to plant growth. Greenhouse gardeners have numerous means for the control of light. In winter, the problem generally involves getting as much light as possible because the natural light is at its lowest intensity. In fact, many greenhouse operators have installed fluorescent lighting as a supplement to natural daylight to increase growth.

During the summer, natural light becomes excessive for best growth of many plants. Reduction of light is relatively simple and easy by the use of the slat shading described under temperature control.

Soils and Fertilizers

Soil serves primarily as an anchor for the plant, permitting it to grow erect so that the leaves are better exposed to light.

End wall of a greenhouse workroom, on which gardening tools are neatly hung. Soils, fertilizers, etc., are stored in large containers.

Roche



It also serves as the storehouse for water and all nutrients to be used by the plant. Hence the condition of the soil becomes an important concern to the greenhouse gardener.

Soils for greenhouse use should be loose in texture to permit adequate aeration of the roots. They should also be able to supply nutrients to the plants. Field soils are seldom satisfactory as they are, for they frequently contain weed seeds and diseases that must be eliminated.

The primary base for a good greenhouse soil mixture is field soil which is sterilized and then mixed with other ingredients. A good sandy loam soil mixed with about one-third organic matter such as decomposed manure makes an excellent greenhouse soil, both for pots and for benches. The mixture should be thoroughly turned and mixed and allowed to stand for two or three weeks before use. If the field soil is a heavy clay, it can be mixed with equal parts of clean coarse sand; then add about one-third organic matter. Mixing in small quantities can be done on a small potting bench conveniently placed in the greenhouse (see illustration). Large quantities can be handled on a floor and turned with a shovel or spade.

Normally, freshly mixed greenhouse soils contain sufficient nutrients to start plants. Later on, fertilizer will have to be added for continued healthy plant growth. The home gardener will find it most convenient to purchase commercially available complete fertilizers from garden supply houses. These places can be helpful in offering advice on the proper feeding of plants.

Soil sterilization is an important practice for new field soils and for soils that are to be reused in order to control diseases and prevent the growth of weeds.

Chemical soil fumigants are available commercially for those who do not wish to steam-sterilize. Directions are usually supplied with the materials for their use in soil sterilization. An electric soil pasteurizer is shown on page 85.

For bench crops, the benches are usually filled to a depth of 4 to 6 inches with



In this greenhouse without attached workroom, storage bins and shelves as well as potting table and record space are placed in the northwest corner.

the greenhouse soil. When pot plants are grown, the benches contain a 2-inch layer of fine gravel or coarse sand. This material forms a nice even base for the pots and at the same time provides the good drainage so essential to healthy plant growth.

Arrangement of Equipment

The amount of equipment needed for a greenhouse operation can range from a few of the more simple tools to a wide variety of tools and equipment. Regardless of the amount of equipment used, good working facilities contribute immeasurably to the success and enjoyment of the greenhouse. A separate garden house or workroom attached to the greenhouse is excellent for storing things and carrying on many of the attendant operations. On the other hand, such space is not always available so that a corner of the greenhouse must be used. The northwest corner is best because this is the area of least light for growing. A handy arrangement is to have a small portable potting bench placed on the end of the bench, with tools and equipment hung on the end wall above (see illustration).

THE SUN-HEATED PIT

An economical and practical substitute or supplement for a greenhouse

Kathryn S. Taylor

NO discussion of greenhouse gardening for amateurs would be complete without delineating the advantages of a sun-heated pit greenhouse. Its upkeep involves a minimum of time and effort; its low initial cost and simple operation require little outlay of money. Yet it is possible to grow fine flowers of many kinds throughout the winter with only the sun as the principal source of heat and light. The structure can serve in place of a small greenhouse or it can supplement one.

A sun-heated pit should be dug about 4 feet deep, and one foot should be filled with drainage material. The excavation should be lined with building blocks or a cement wall. The pit should face due south and should have glass on the south side only. Hotbed sashes, 3 by 6 feet, are frequently used, slanted at an angle of

45 degrees to make full use of the sun's rays in winter. The north side should have a shingled roof. While this can be given the same angle as the glass on the south side, this wastes space unnecessarily; it is more practical to have the north roof at a less steep angle, thus allowing more height for tall woody plants, such as camellias, which may be stood on the ground or on a two- or three-step staging along the north wall inside.

No artificial heat beyond electric light bulbs is needed unless the outside temperature drops below zero. Light bulbs totaling 300 watts, installed beneath the bench, give more than adequate protection in frigid weather. If the gardener wants his pit to serve as a cool greenhouse, small electric heaters with thermostatic control are satisfactory and not too expensive to run.



Lloyd D. Brace

A pit greenhouse with attached potting shed. Note insulating "curtains" to be pulled across the glass before the sun goes down on winter days.



Courtesy of Massachusetts Horticultural Society

Interior of the author's pit greenhouse. The north roof (on right) is shingled and the ventilators are capped for the winter.

All parts of the pit above ground, save the glass, have double walls with fiber-glass insulation. In winter the glass is covered, before the sun goes down, with quilted pads over which tarpaulins are rolled down to keep them dry. One pit owner uses styrofoam planks over each hotbed sash, each wrapped in polyethylene to keep it dry. Clear plastic stapled to the under side of the sashes gives still better insulation. A space should be left at the bottom for accumulated moisture to run off.

It is important to arrange for sufficient ventilation in the pit. In addition to a door in one end and an opening in the other, there should be two ventilators in the north roof and hinges on at least two of the hotbed sashes which form the south roof of the pit. The installation of two small electric fans diagonally placed at opposite ends of the pit near the top in a manner to keep the air in constant circulation is a great advantage. The fans remove all traces of stagnant air, one of the chief objections to this type of glasshouse. An exhaust fan in one

end will change the air very quickly during dull winter weather. Of necessity the door in this type structure is quite low, because of the angle of the roof. The presence of an enormous boulder, which it was not feasible to remove, was responsible for the small door in the writer's pit. When it becomes difficult to bend over, as old age approaches, some other arrangement will become imperative. Most modern pits have a regulation door and a little potting shed at the entrance, which makes for much more efficient use.

If the sun-heated pit is run very cool, without artificial heat, as originally intended, no extra illumination is needed except on cloudy days when the glass is not uncovered. Fluorescent lights installed over the bench under the glass give artificial daylight at such times. If set up over a propagating bench or over seedlings, sturdy plants with splendid root systems will result. Large plants in pots will also benefit from this kind of light.

The choice of plant material for the



P. I. Merry

The author's pit greenhouse with tarpaulins rolled down to keep the quilted pads dry.

pit is limited by the average temperature at which it is run. If it stays just above freezing for much of the winter, camellias

will provide most of the color in the coldest weather. Other dependable favorites include *Primula malacoides*, *P. polyantha*, winter-flowering pansies and forget-me-nots, wallflowers, species cyclamen, South African bulbs such as *Nerine* and *Ixia*, all the Dutch bulbs and such tender woody species as *Trachelospermum jasminoides*, *Daphne odora*, *Loropetalum chinense*, *Teucrium fruticans*, rosemary and tender rhododendrons.

Tender perennials from the garden, such as *Nierembergia rivularis*, *Salvia patens* and lemon verbena can spend the winter in the pit. Dahlia tubers, simply laid on the ground in an out-of-the-way spot, neither shrivel nor rot.

The many good uses to which a sun-heated pit can be put are determined by the needs and interests of the winter gardener. To those who already have one, it seems like an indispensable adjunct to the small greenhouse.

How and Where to Obtain Greenhouse Plants in Small Quantities

A PROBLEM for the small greenhouse owner is: Where can he buy 12 carnation plants, a few sweet pea seeds, or 25 snapdragons of various colors? The answer probably lies in making friends with a local greenhouse florist. After all, he should be interested in any person who enjoys flowers, and he may be willing to sell a few surplus plants especially if he knows the purchaser is not planning to be a competitor. An added advantage of getting plants from a local florist is that they will be ready at the right time of year. All too often the home gardener remembers Easter lilies in April; the professional florist planted his bulbs the previous October.

It is important for amateur greenhouse owners to understand that garden varieties of flowers do not always prosper when they are planted in greenhouses. Special strains of winter-flowering snapdragons, winter-flowering sweet peas, and large-flowered carnations, as well as many other plants, have been adapted by plant breeders to perform under greenhouse conditions.

Certain seed merchants, catering to owners of home greenhouses, now have special sections of their catalogs devoted to seeds for greenhouse planting. Fellow greenhouse gardeners are a good source of cuttings or of particular plants, as are the "swap" columns of flower magazines and bulletins of various plant societies.

The new owner of a home greenhouse would do well to send for catalogs of many of the companies that sell orchids, camellias, cacti, house plants or other specialties. The search for unusual plants is a compelling one limited only by the ingenuity of the gardener.—J.U.C.

NEW ARTIFICIAL MEDIUM FOR PLANT GROWTH

An experimental opportunity for amateurs

A NEW synthetic growth medium which contains some features formerly found only in soil and other natural media, is reported in the *American Orchid Society Bulletin*. Not only does it give the plant support for an upright position, but it has open cellular structure for root penetration and aeration; takes water without waterlogging; is nontoxic to plant roots; does not decompose; is odorless, light in weight, easy to handle, and is flexible enough to fit any container. It is also easy to pack for air shipment of plants. Furthermore, it has a new ion-exchange nutrient system incorporated in it during manufacture.

It is a complex foam made from an open-cell-forming polymeric agent which will remain stable when solids in limited amount are added to it in advance of its formation. Some of the solids that have been provided for the benefit of growing plants are insecticides and fungicides, hormones for growth regulation, and silica gel to aid in water distribution. Perlite, vermiculite, charcoal, activated carbon, agar-agar, gelatin dyes, and pigments, besides the ion-exchangers, have also been added.

The material can be made to take any shape. Slabs can be cut or sawed from it, and plants can be grown in holes that are drilled in these. By hammer-milling, it can be used like any granular medium. A "totem pole" for clinging plants has been devised with a perforated pipe for support and watering running through the center. Molded or cut blocks can serve as hanging baskets.

Most unique is the "in-place foaming" of clean-rooted orchid plants. The roots are held at the proper level in an empty container. The foam, before it is stabilized, is allowed to fill the remaining space. No watering is done until the foam has set. The air spaces in the foam

permit normal development of the roots, and the plant continues its natural growth.

The material can be foamed on a bare greenhouse bench, around patio posts where planting is desired, or at the base of shade trees on the lawn for the culture of any type of plant. Provided that atmospheric requirements of heat, light, humidity and aeration are correctly supplied, the only attention said to be needed by plants grown in the synthetic foam is watering.

The report is made by M. F. Handley of the Organic Product Development Laboratory of the Dow Chemical Company, which created the growing medium, and A. J. Proebstle of the Proebstle Orchid Farm, Brazoria, Texas, where tests have been made with the new substance.

Synthetic growing medium takes shape of pot. (*Below*, plant has been removed from its pot.) While especially adapted to orchid culture, the medium is said to be usable in block, foam or granular form for many types of plants.

Courtesy of American Orchid Society



GROWING GUIDE FOR A COOL GREENHOUSE

45 to 50 Degrees

NAME	PLANT SEEDS, BULBS, CUTTINGS	DATE TO BENCH	TIME OF BLOOM*
Agathaea	Jan.	July	Dec. thru May
Ageratum	Aug. 15	Sept.	Feb. — late spring
Alyssum	Aug. 15	Aug. 15	Dec. thru spring
Anemone	Sept.	Sept.	Jan. thru March
Yellow Daisy	Cuttings — July — Aug.	Nov.	Feb. 15 on
Bouvardia	Cuttings — Feb.	May	Dec. thru Jan.
Browallia	Seeds July — Aug.	Pot Sept. — Oct.	Jan. on
Calceolaria	July to Aug.	Oct.	May thru June
Calendula	July to Dec.	Sept. thru Feb.	Nov. thru May
Campanula		Clumps Dec. 15 on	May
Candytuft	Dec.	Flat — late Jan.	May thru June
Carnation	Cuttings Dec. — Mar.	May thru June	Late Nov.
Chrysanthemum			
early	March	May	Sept. thru Oct.
mid-season	April	June	Oct. thru Jan.
late	April thru May	July 15	Dec. thru Feb.
Cineraria	May thru Aug.	July thru Oct.	Christmas on
Cyclamen	July and Aug.		Nov. thru April
Daphne	Coldframe plants	Feb. 1	April thru May
Didiscus	Aug.	Oct.	Feb. thru April
Forget-me-not	March	Sept.	Dec. thru spring
Freesia	Aug. thru Sept.	Aug. thru Sept.	Dec. thru Feb.
Genista	Established plants	Sept. thru Oct.	March thru April
Gladiolus	Dec. thru Feb. 1	Dec. thru Feb. 1	May thru June
Gypsophila	Sept.		Dec. on
Kalanchoë	March	Jan.	Feb. thru April
Larkspur	Nov.		March thru June
Marguerite	Cuttings — March	Aug. thru Nov.	Dec. thru Jan.
Marigold	Aug. 1	Sept. 15	Nov. thru Jan.
Nasturtium	Sept.	Sept.	Dec. thru June
Nemesia	Dec.	Flat — late in Jan.	May thru June
Pansy	July thru Aug.	Nov.	Dec. thru March
Primula —			
sinensis	March thru April	May	April on
malacoides	Aug.	Oct.	March and later
obconica	May	July	Jan. and later
Ranunculus	Oct.	Oct.	Feb. on
Salpiglossis	Dec.	Feb.	May thru June
Schizanthus	Aug. Nov.	Oct. Jan.	March thru April March thru June
Snapdragon	Jan. Aug. thru Nov.	March Aug. thru Nov.	April thru June Dec. thru May
Stevia	Cuttings Mar. — Apr. Nov. thru Feb.	Sept. Jan. thru Apr.	Dec. thru Feb. Apr. thru June
Stock	July thru Sept. Jan. thru Feb.	Aug. thru Oct. Jan. thru Feb.	Christmas thru Feb. April thru June
Sweet Pea	June Aug. thru Nov.	June Aug. thru Nov.	Sept. thru Dec. Nov. thru May
Wedgwood Iris	Late Oct.	Late Oct.	Jan. thru Feb.

*The early dates are based upon optimum growing conditions.

(Courtesy of Lord & Burnham)

GUIDE FOR MODERATE TO WARM GREENHOUSE

55 to 70 Degrees

NAME	PLANT SEEDS, BULBS, CUTTINGS	DATE TO BENCH	TIME OF BLOOM*
Amaryllis	Sept.	Oct.	Jan. thru Feb.
Astilbe	Chumps after frost	Nov.	90 days
Azalea	Pot when received	Jan.	Feb. 15
Asparagus-fern	May	June	1 year
Begonia semperflorens	Jan. thru Feb.	Pot in April	Aug. thru Dec.
Begonia, Christmas	Cuttings in Nov.	12 months later	Dec. thru Jan.
Bougainvillea	Bench March thru April	Pot in June	April thru May
Calla, Yellow	Flat — peatmoss, high temp.	Nov.	March thru April
Calla, White	Sept. thru Dec.	Sept.-Dec.	Feb.
Christmas Cactus		Oct.	Dec. thru Feb.
Coleus	Cuttings — Sept.	Oct.	Spring
Daffodil	Pot or Flats — Oct.	Jan. thru Feb.	4 weeks
Enphorbia fulgens		July thru Aug.	Dec. 17 thru Jan.
Boston Fern	Runners in July		12 or more months
Gardenia	Cuttings — Nov. thru Dec.	Sept.	Christmas on
Geranium	Cuttings — July and Aug. Seeds — Feb. thru March	Aug. thru Oct.	May
Gerbera	Divide June	Aug. thru Sept.	Dec. on
Gloxinia	Seeds in March		Aug.-Sept.
Hydrangea		Jan.	April thru May
Hyacinth	Pot in Oct.	Jan. thru Feb.	3 to 5 weeks
Kalanchoë	Jan.	Aug. and Sept.	Dec.
Lantana	Cuttings Aug — Sept.	Sept.	May on
Lilium auratum	Pot singly, 8-9 cm. bulbs	May	Jan.
candidum	Pot Aug. thru Sept.	March 15-30	May
erabu	Pot Nov. thru Dec.	Nov. thru Dec. Sept.	Feb. thru April
formosanum			Jan.
giganteum	Nov. to Dec.		3 to 5 months
regale	Pot 18 cm. bulbs Jan.		March thru April
speciosum album	8-9 cm. bulbs Aug.		Jan.
speciosum rubrum	Pot April thru Dec.	April thru Dec.	Sept. thru June
tenuifolium	Pot Oct.	Feb. thru Mar.	8 weeks
tigrinum	Pot June thru July	June thru July	Oct. thru Nov.
Philodendron	Cuttings — Oct.	Nov. 1	12 months
Poinsettia	Cuttings June — Aug.	Sept. thru Oct.	Christmas on
Roses in pots	Pot when received	Jan.	12 weeks
Saintpaulia	Cuttings Dec. — Apr.	March thru May	Nov. thru Feb. 14
Tulips	Pot. Oct.	Jan. thru Feb.	4 to 6 weeks

*The early dates are based upon optimum growing conditions.

(Courtesy of Lord & Burnham)

HINTS FOR THE NEW OWNER OF A SMALL GREENHOUSE

Alys Sutcliffe

FOR the novice who is at a loss in managing the greenhouse he has just acquired, here are a few suggestions for things to do and not to do:

What to Do

For Convenience

Do have a small potting room attached to the greenhouse. Using a bench is much easier than trying to do potting in the greenhouse itself where space is limited. The potting room also provides storage space for flower pots, fertilizers, and sprays. It is important to have soil (which should be sterilized), sand, peat moss and (if available) leaf mold indoors before freezing

weather starts. These may be neatly stored in garbage cans, metal or plastic, in the potting shed. Many pleasant days may be spent working in the greenhouse, with the snow falling outside, when the necessary materials are near at hand.

When potting, be sure to use clean pots; dirty ones are easily scrubbed clean. Save all broken ones to use as crocks for drainage in the bottom of pots.

Temperature and Air

In winter keep the temperature at about 50-55°F. at night (though many plants will stand 40-45°F. without harm), and 60-65°F. in the daytime. Open the vents on sunny days even if just a crack and for only a few minutes; plants need air.

Moisture—When and How

Damp down the floors and benches on sunny days and water those plants that need it; on warm sunny days spray the foliage early to allow it to dry before night.

Water plants individually; some need more moisture than others. In a greenhouse that is not kept excessively warm, plants need less water in winter than when weather is warmer. Expect some of your plants to remain in a more or less dormant state until days begin to lengthen.

Cleanliness and Health

Keep all dead leaves picked up and keep floors and benches clean; refuse breeds diseases and insects. Watch carefully for indications of trouble. At the first sign of insects start a spray program. Isolate or discard all diseased plants.

Wash the pots about once a month and loosen up the surface soil with a pointed stick or old kitchen fork.

Periodic Practices

Start fertilizing about the end of February, or March, depending on the plants you grow.

Shade the sunny side of the greenhouse when the weather gets warm and sunny—usually about May in the North. The greenhouse will stay cooler and plants will not dry out so quickly.



A neat, convenient place for handling pots and plants and for storing greenhouse materials.

Summer Care

Try to clean out the greenhouse completely by about the end of June or early July. Most plants benefit by a month or so out-of-doors in the shade of trees. The only ones to be left in might be a vine or two climbing up to the roof; these should be pruned and sprayed well. The greenhouse can be thoroughly cleaned, repainted if necessary, the gravel well washed, benches and gravel sprayed with a miticide, and fresh sand or peat moss put in the cutting bed. As the plants are brought back in at the end of August they should be carefully examined for pests picked up out-of-doors.

Once the greenhouse is clean it is ready for sowing of perennial seeds or taking cuttings in August.

Automation

If you can only give your greenhouse attention once or twice a week, have heating, ventilation and moisture all automatically controlled.

What Not to Do

Do not overcrowd your greenhouse until you are better acquainted with the plants you are growing. It is possible to have every inch of space utilized and still have healthy plants. This comes with practice, by trial and error.

Do not water on dull snowy or rainy days unless some individual plant needs it.



Many greenhouse plants, especially woody ones, are best set outdoors in partial shade in summer, their pots plunged to the rim in the ground. Keep them watered thoroughly.

Do not allow pests and diseases to take over before you discover them; otherwise it is almost impossible to control them.

Do not overwater plants at any time; neither leave them to dry until they wilt; this is as bad for them as overwatering.

Do not use old soil over again when repotting your plants. It pays to use fresh sterilized soil.

Do not get discouraged at your failures, but try again.

KEEPING FLOWER POTS CLEAN

To keep ordinary red clay flower pots from developing the green (often slimy) algal growth so commonly seen in greenhouses, they may be treated with a disinfectant known as Algicide (Nu-Tone Products Co., 1515 Platte Street, Denver, Colorado). Drs. Neil Stuart and H. M. Cathey of the U. S. Department of Agriculture report that a 10% solution of Algicide, used as a dip, will keep flower pots free of algae for about six months. The dip is prepared by adding nine parts of tap water to one part of the disinfectant.

CHEMICAL DWARFING

Many attractive plants that normally grow too tall for the small greenhouse can now be chemically dwarfed to desired heights, yet the flowers will be of normal size. Warning: a dwarfing chemical for one kind of plant may be completely ineffective on another kind. For example, the commercially available phosfon-D (Virginia Carolina Chemical Co., 401 E. Main Street, Richmond, Virginia) has been found effective in reducing stem length of chrysanthemums, petunias, Easter lilies, rhododendrons and azaleas, but has no effect on carnations, fuchsias, snapdragons or red poinsettias. In contrast, cycocel is effective on red poinsettias, but not petunias. Research on chemical dwarfing is one of the U. S. Department of Agriculture projects at Beltsville, Maryland, and Dr. H. M. Cathey is the Research Scientist principally concerned with the work. Write Dr. Cathey for "how to" information.

GREENHOUSE LILY CULTURE

Careful timing brings bulbs into bloom for Easter

John Swander

IN August the lily bulbs begin to arrive, *Lilium candidum* and *L. harrisi* among the first. The madonna lily (*L. candidum*) is but little used today for indoor flowering, but it can be successfully brought into bloom in pots in late April and May if grown in a coolhouse. The white trumpet lily (*L. harrisi*, better known as *L. longiflorum eximium*) will flower during December and January if given a 65- and 70-degree house when well under way. Several varieties of this species are grown as Easter lilies. Cold storage bulbs of "giganteum," the white flowers of which are flushed with purple before they open, may likewise be planted in August.

Other Kinds Available

At the same time, *L. rubrum* and *L. auratum*, also available from cold storage, may be started in the greenhouse. Allow 15 weeks from planting to bloom, giving them a 60-degree house during the last four weeks.

The Erabu type of white trumpet lily (also called "formosum"), if planted in October, will start coming into bloom during February and March.

During December, imported giganteum bulbs can be planted. Allow at least 14 weeks for them to come into flower. That will mean late March or April depending on how warm the plants are kept after showing buds, which should be about six weeks before Easter.

Preparations for Planting

Before your lily bulbs start to arrive, you should have pots and soil ready so you can plant the bulbs as soon as they reach you. Use clean pots and sterile soil.

Pasteurize your soil (p. 85) or use any of the chemicals on the market today, such as Vapam or chloropierin. Whatever you use, make sure that you read and follow manufacturer's directions.

Use a fairly porous soil and have good drainage in each pot. I prepare a soil mixture of one part rotted cow manure, one part composted soil, and one part coarse sand with some coarse screened well-leached hard coal ashes. I use a 6- or 7-inch pot for bulbs of 7 to 8 or 9 to 10 size.

Forcing Lilies for Easter

Most of the lilies used for forcing for Easter are varieties of *L. longiflorum*, such as 'Croft,' 'Estate,' 'Florida,' and 'Creole.' For the past 15 years I have been forcing the 'Estate' lily, West Coast grown, which reaches me about November 15. Bulbs are potted upon arrival, put in a coldframe, covered with 3 inches of sand and 4 inches of salt hay. They are left outside in the coldframe until December 25. By that time they are well rooted and are brought into a 50-degree house. At the end of two weeks, they are brought into a 60-degree house, where they remain until they flower for Easter.

As soon as lilies start to show growth, it is necessary to spray to control aphids. These pests transmit virus diseases that can cause severe damage or even death to lilies. If spraying is not started until aphids are observed, it may be too late to prevent disease.

Whatever the date of Easter, it is possible to have plants in bloom. In a temperature of 60 to 65 degrees, it takes from 110 to 120 days for flowers to open. If buds are showing six weeks before Easter, you are safe.



Gantner

White trumpet lilies (*Lilium longiflorum* or—as often listed—*L. harrisi*) have become the traditional Easter lilies. The date of their blooming can be made to coincide with Easter by special cultural methods.

Influence of Weather

Weather conditions, however, are bound to play an important part in the time of flowering. A cold dark winter may cause you to miss an early Easter. Mild sunny weather, on the other hand, may bring the plants in too early.

If plants are a little too far advanced and kept cool to hold them back for a certain date, they will produce nothing but split flowers. A sudden drop in tem-

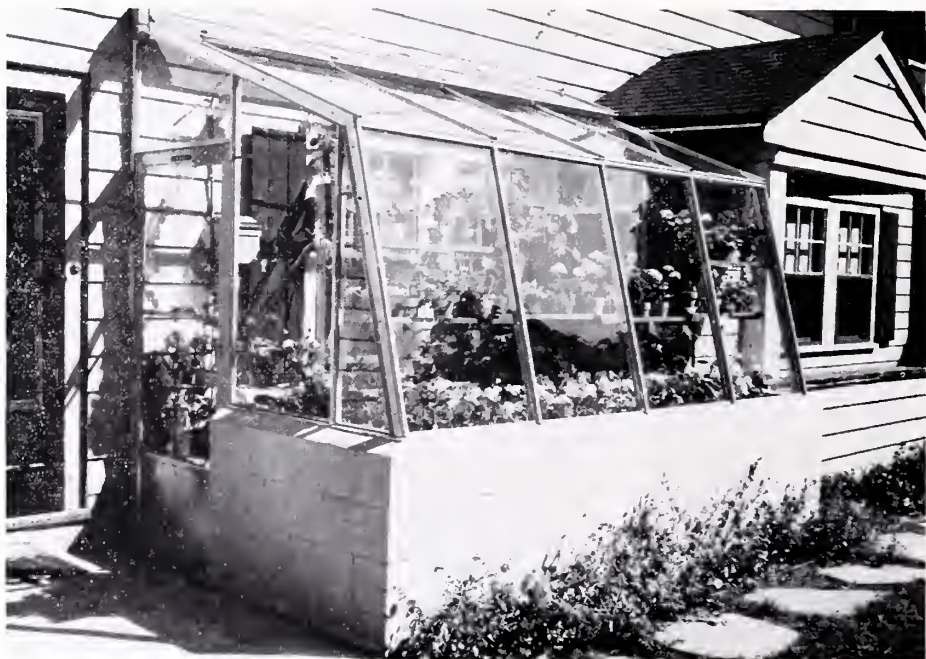
perature with the buds partly advanced is also likely to result in splits.

Always bear in mind that the harder you force, the more particular you must be with the watering. Never use cold water; take the chill off. To bring the 'Estate' to flower for an early Easter, I water daily with water heated to 110 to 115 degrees. Also when plants get well established, I feed twice a week with Hyponex at one-half the amount recommended until the flowers show color.



GERANIUMS IN THE HOME GREENHOUSE

Helen Van Pelt Wilson



Courtesy of Lord & Burnham

Geranium flowers show up brilliantly through greenhouse glass.

GERANIUMS, or more properly pelargoniums, are among the most interesting and colorful plants you can grow in the home greenhouse. Because of their considerable diversity of habit and foliage they are fascinating to collect, and the tendency of mature, well-tended plants (but not left-over garden subjects) to bloom the year round brings almost constant color. Only a long succession of sunless weeks, as sometimes occurs in winter, will check bud formation.

A cool greenhouse with night temperatures of 45 to 50 degrees F. suits most pelargoniums. Below 45 degrees single zonals will bloom, but other types need up to 50 degrees, with 60 degrees F. the

ideal for daytime. This is cool enough to prevent soft weak growth; plants bloom best if wood is firm and short jointed. Some fluctuation in temperature is tolerated, but not continuous high heat, although up to 70 degrees is not injurious.

In the same coolhouse may be grown anemones, tuberous and wax begonias, bouvardia, calceolarias, cinerarias, cyclamens, freesias, marguerites, pansies, primulas, and Wedgwood iris.

In the moderate to warm greenhouse, 55 to 65 degrees at night, pelargoniums will thrive provided they are given the sunniest possible positions, along with astilbes, tuberous and wax begonias, cacti, callas, coleus, gloxinias, such lilies as

Lilium auratum, *L. candidum*, *L. regale*, and *L. speciosum*, and the spring-flowering daffodils, hyacinths and tulips.

Basic Culture

Keep the mature geraniums that you hold over from one year to the next in as small pots as possible, but renew the worn-out soil. Pinch back new growth to make plants stocky. For good winter display, in August take 3-inch cuttings with two or three nodes of firm but not woody growth. Insert each in a little wad of sand (hormone dip not necessary) in a 3-inch pot of soil mixture to avoid repotting. In most cases cuttings root in two to three weeks and first flower buds come in ten to twelve weeks.

These then are essential cultural requirements: full sun, pruning to promote bushy growth, tight potting, rather low humidity (geraniums are not tropical plants), good ventilation (even in winter), a firm but not cemented potting soil, and a proper amount of water.

Young plants and dwarf varieties may need watering every day even in winter, but established plants may need watering

only twice or maybe once a week in dull weather. The best guide is the *feel* of the soil, just dry to the touch between thorough soakings. A sudden yellowing of lower leaves is a pretty sure indication of too little water.

Plants in *active* growth need fertilizer about once a month. Follow the manufacturer's directions (or give a little less). If leaves are paler than normal for a variety and flowers small or sparse, fertilizer may be needed, but if leaf growth is lush but plants are not blooming, fertilizer should be withheld. Geraniums are not heavy feeders and an abundance of foliage with few flowers is usually the result of too much fertilizer or one too high in nitrogen.

Kinds to Select

For variety and rich flower or leaf color—or both—select pelargoniums mainly from three broad classifications: zonals (both standard and dwarf), colored-leaved and scented-leaved. If you wish, add a few oddities among climbing and cactus types. The ivy-leaved (*P. peltatum*) and Lady Washington (*P. domesti-*



Colored-leaved geraniums. *Left to right*: 'Miss Burdett Coutts,' 'Velma Cox,' 'Skies of Italy.'

Graf



Graf

'Mars' is a typical dwarf, with a full-sized bloom atop a miniature plant.

cum) geraniums are likely to be disappointing. While ivy-leaved geraniums make fine green vines in winter, they depend more on sunshine for bloom than the zonals, at least in my experience. If conditions suit them, if the weather is bright, if they have been regularly fed, they should bloom from late February on. To keep them through the summer, they need a climate that is not too hot and humid.

Lady Washington geraniums require careful scheduling to get much winter bloom. The florists manage them for Easter, Mother's Day and Memorial Day. This means rather late spring flowers in a home greenhouse where color is particularly desirable in winter.

Zonal Varieties

The zonal geraniums, *P. hortorum*, with dark circular markings on green scalloped leaves, are the ones everybody knows. Double forms dominate the trade, and for sheer force of color, they have few rivals. These are some handsome doubles: 'Merry Garden White,' 'White Magic,' 'Always'

(semidouble white with pink toward center), 'Dreams' (salmon pink), 'Old Rose' (semidouble), 'Lavender Ricard,' 'Orange Richard,' 'Olympic Red,' 'Pride of Camden' (dark red), and 'Patience' (the "bluest").

More graceful, more tolerant of cool nights, and with flowers of more perfect form are the exquisite single zonals, such as the luminous 'Starlight,' salmon-pink 'Honeymoon,' blush 'Pink Snow,' pale lavender 'Helen Van Pelt Wilson,' brilliant orange 'Tango,' and bright red 'Paul Sloan.'

The Smallest Kinds

Dwarf forms of zonals mostly have rather large flowers on quite small bushy plants. A collection of fifty would be easy to assemble, but unless you are pressed for room, remember that standard types give a richer display in the greenhouse. Also, the dwarfs do not slip well and need to be watered and fertilized with considerable care. The smallest kinds like 'Black Vesuvius' can stay in 2½-inch pots for years. 'Pigmy' is distinctive with tiny, bright red, double flowers in proportion to the 6-inch plant. 'Elf' (in foliage,



Graf

'Lady Plymouth' is a scented geranium with variegated leaves.

a golden tricolor), 'Fairyland' (a silver tricolor), 'Lup,' and 'Perky' are attractive miniatures. Somewhat larger but still small are 'Little Darling,' 'Nugget,' 'Ruffles' and 'Red Spider.'

Bird's-Eggs and Rosebud

Catalogs list as "unusual and fine-flowering" some very lovely zonals. Bird's-egg geraniums, singles and doubles, are stippled; the group called Jeanne or Carnation has serrated petals. I like particularly such Rosebud geraniums as 'Apple Blossom' that never open fully their pretty double rambler-rose buds. The Poinsettia or Cactus-flowered group has pointed petals of different lengths; the Phlox type has eyed flowers like some garden phlox, while New Life geraniums have narrow, flecked and striped petals. Painted Lady geraniums are charmers, such as 'Alice of Vincennes,' 'Berkeley Belle' and 'Lady of Spain.'

Succulent and Spiny Sorts

Other out-of-the-ordinary pelargoniums are the climbing and cactus-stemmed species that scarcely seem to belong to the genus *Pelargonium*. These are fascinating but not always beautiful, although *P. gibbosum* with its scented greenish-yellow spring flowers certainly is, except when



Graf

The succulent-stemmed geraniums are curiosities rather than plants of beauty. This one is *Pelargonium crithmifolium*.

dormant. Others to search for are *P. rutaceum*, the rue-scented storksbill; *P. scandens* with prickly stalks and flowers lovely as an orchid, and *P. fulgidum* with tubers like beads on a string.

Colored and Scented Leaves

The colored-leaved geraniums have amazing variety, the foliage often being of more interest than the flowers. Aside from the dwarfs in this group like 'Variegated Kleiner Liebling' (Little Darling), there are fifty varieties among tricolors like 'Mrs. Cox,' bicolors or "butterfly geraniums" like 'Happy Thought,' silver-leaved ones like 'Mountains of Snow,' and green-leaved like 'Cloth of Gold.'

The scented-leaved geraniums appeal particularly to all of us who appreciate fragrance in plants. More than seventy-five varieties could be collected here in six rather well-defined classifications of Rose, Lemon, Fruit, Mint, Spice, and Pungent, the odor of the slightly bruised leaf giving the clue. Only when the sun is strong and the greenhouse warm are the volatile oils naturally released to enliven the air with sharp herbal scents.



Graf

Pelargonium quercifolium has rose-scented foliage. The species name "quercifolium" refers to its oak-like leaves.



GESNERIADS

Genereux

Streptocarpus varieties. The Weismoor hybrids flower within a year from seed.

Colorful flowers and ornamental foliage give this varied family special value in the home greenhouse

Elvin McDonald

IT took a relative newcomer among the gesneriads to bring attention to the family as a whole. Carl Linnaeus (1707-1778) knew about the *Gesneriaceae* and described four genera of them. But it was not until the African violet (*Saint-paulia*), which had been discovered toward the end of the 19th century, rose to popularity some forty years later, that interest in the family spread. Today, more than eighty different genera and 500 species of gesneriads are known. Countless hybrids, chance seedlings and mutations exist.

As components of a family, these can be described as handsome, often velvety-leaved plants with wheel-shaped, tubular or bell-shaped flowers, frequently of vivid

coloring. So variable are they that a greenhouse could be filled with them, and only a taxonomist would be aware that all were members of the same plant family.

Basic Cultural Requirements

Gesneriads are suited to a warm greenhouse in the winter—one with a nighttime minimum of 62 to 65 degrees F. They like moist but fresh air with a relative humidity of at least 50 per cent. In the dead of winter gesneriads need several hours of direct sunlight, even all day, but as the season changes to spring, they need shading. My own greenhouse has Lumite Saran shade cloth on it around the year. This shading permits about 50

per cent of the sunlight to enter.

Gesneriads thrive in humusy, moist soil. A mixture of equal parts of soil, sand (or Perlite), peat moss, and leaf mold does very well, as will other spongy mixtures that are used for tropical plants. Gesneriads in active growth need to be fed. House-plant fertilizers common on the market give good results. The organic fish emulsion fertilizers are excellent, especially for the foliage-type gesneriads like episcia and nauticalcylx.

Most gesneriads go into dormancy after a heavy flowering season. This is more pronounced for those with tubers and scaly rhizomes than those with simple fibrous root systems. Storage temperatures ranging from 45 to 65 degrees are all right; 55 to 60 is probably ideal. To prevent shriveling, keep resting tubers and rhizomes barely moist, either in the pots of soil in which they grew, or in plastic bags. Keep in a dark place where mice cannot get to them. Watch for new sprouts, and when they appear, repot in new soil, and place in good growing conditions. If sprouts should appear too early to suit your plans, snap them off. You can do this several times without harming healthy tubers and rhizomes.

Gesneriads with fibrous root systems—

African violets and episcias, for example—are rested by withholding fertilizer for several weeks, and by keeping the soil slightly drier than usual. The end of this period is a good time to repot them in new soil, trimming back old leaves and roots at the same time.

Thirteen Recommended Gesneriads

There are 13 different gesneriads which I find worthy of space in my home greenhouse. After you grow these, you may want to experiment with some of the more unusual kinds. Membership in the American Gloxinia Society will help you learn about these, how to handle them and where they may be obtained.*

Achimenes

Small, scaly, catkin-like rhizomes, planted from January through April, are the starting point for the showy flowers of achimenes. They need bottom heat (about 72° F.), and a very humusy soil mixture kept just barely moist until top growth is visible. The scaly rhizomes at first appear to be nothing; but plant six in a 6-inch pot, pinch out the growing tips when plants are 2 to 3 inches tall, and you will be amazed at the floral display from July until fall. When the plants begin to look bad in autumn, dry off gradually by withholding water.



Park

Plants of achimenes blossom profusely six months after they are planted.



Park

Each flower has individual beauty. Shown here is achimenes 'Purple King.'

*American Gloxinia Society, Box 608, Merrick, Long Island, New York.

Store the scaly rhizomes in the pots in which they grew, keeping the soil only slightly damp, or sift them out in the fall and store them dry in a bag of vermiculite at about 55° F. until planting time the following year. Flowers of achimenes come in many colors, with purple, red and blue predominating. They are excellent plants for hanging baskets, pots and window boxes.

Aeschynanthus

Waxy foliage, similar to that of the wax-plant (*Hoya carnosa*), characterizes the species of *Aeschynanthus*. They are especially good as hanging basket plants. *A. pulcher* is sometimes called lipstick-plant, and the unopened red flower buds in their long brown calyxes do resemble lipstick in a tube. You may plant this gesneriad in pure unmilled sphagnum moss packed into a generous-sized hanging basket, and grow it like an epiphytic orchid. Feed regularly with liquid house-plant food, and keep the moss constantly moist. Blooms may come at any time.

Columnnea

Similar to *aeschynanthus* in that it makes a good basket plant and may be grown in sphagnum moss. Tip cuttings root easily in spring or summer, and flowers may come at any time. There are many different columnneas; the red-flowered *C. gloriosa*, *C. hirta* and 'Stavanger' and the yellow *C. tulae flava* make a nice starter collection.

Episcia

Episcias are glorious foliage plants. You may choose from species and cultivars with plain, shiny green leaves or highly colored, hairy foliage; with scarlet, yellow, white or lavender-blue flowers. Episcias grow stolons or runners like those of strawberries. When allowed to hang, the stolons quickly form a graceful cascade. Sudden chilling below 55° F. may cause episcia foliage to droop as if it had been frosted. Warmth (65-85° F.), high humidity and long hours of good light encourage episcias to flower.

Gloxinia

Members of this group are intergeneric hybrids between *Sinningia* (the gloxinia of florists) and *Reichsteineria*, and they bear the large, brightly colored flowers of both parents. They are grown as the parents are (see below), and make exceedingly good flowering plants to be brought to maturity at almost any season, especially when



Generous

Columnnea allenii is a spectacular gesneriad whose large flowers are borne from base to tip of its long trailing stems.

warmth, considerable sunlight and moisture are available.

Gloxinia perennis

The true gloxinia makes an interesting plant. It has a scaly rhizome like achimenes, but larger, and can be planted at the same time and handled similarly. Pinching is not recommended, however, as the stems grow strikingly tall when allowed



'Queen of Hearts' is a double-flowered gloxinia (a variety of *Sinningia speciosa*).

Park

to develop. Staking may be necessary. Foliage is metallic silver on top, maroon beneath. The blue flowers in summer and fall are reminiscent of Canterbury bells.

Kohleria

Scaly rhizomes of kohleria, usually larger than those of achimenes, may be planted in a slightly moist, humusy soil at any time they are available. Bottom heat will help to start them into growth. *K. cernantha* (also known as *Isoloma hirsutum*) grows to 4 feet or more in height and makes a handsome greenhouse plant, with its hairy leaves and purple flowers. *K. amabilis* is daintier, usually not above 20 inches tall, and its pink, red-spotted flowers come over a long season.

Nautilocalyx

Valuable as foliage plants, with leaves often colored red or bronze. They like warmth, humidity, moist humusy soil and shade to partial sun. The plants usually stay under 36 inches. Tip cuttings root easily at any season. Species cultivated include *N. bullatus*, *N. forgeti* and *N. lynchi*.



Gatteri

The true gloxinia (*G. perennis*) is a long-stalked plant with blue flowers somewhat the shape of Canterbury bells.



Temple-bells is the popular name for *Smithiantha multiflora*. Numerous hybrids are available.

Reichsteineria

Bright tubular flowers (usually scarlet) and good foliage mark reichsteinerias as outstanding plants for greenhouse culture. *R. leucotricha* has hairy leaves of sage green. *R. cardinalis* and *R. macropoda* have plain green leaves. Plant seeds, tubers, leaf cuttings, or young plants at any time. Full sun in winter will promote compact growth and flowering.

Saintpaulia

African-violets are not often seen in greenhouses—strange, too, for as house plants they are nearly perfect. But in a mixed collection it is sometimes difficult to please them. They resent cold water on their foliage: 10 degrees' variance from the atmosphere causes spotting. The saintpaulias like warmth (preferably a low of 68 degrees F. at night), moderate humidity, nicely moist soil and some sun in the dead of winter to encourage flowering. When handled well in the home greenhouse, few plants will give as many flowers over such a long season as the African violet.

Sinningia

The gloxinia of florists (*Sinningia*) is the most valuable of the gesneriads for the home greenhouse. Scalloped, sometimes ruffled, basal leaves 6 or 8 inches long surround the stems that bear the large bell-shaped flowers of purple, crimson or white, the colors often in combination.

The best way to start gloxinias is from seeds. Plant them five or six months before blossoms are desired. I am especially successful with a sowing of seeds made in the summer. Plants will be in full bloom the following February, March and April. Tubers and started seedlings are available by mail from specialists whenever the weather is warm.

Smithiantha

Naegelia (the former botanical name) or temple-bells is a showy plant in the home greenhouse. Bright trumpet-shaped flowers with spotted throats open over a long period on an erect stalk. The broad, pointed, toothed leaves are heavily veined in brownish red. I recommend any named varieties, the new hybrids originated at Cornell University, or seed-grown plants of strains like *S. multiflora nana*. Sow seeds in May or June, or plant the scaly rhizomes in sum-



Schulz

Streptocarpus saxorum is a distinctive small-leaved trailing plant with white and lavender flowers in late winter.



This single white gloxinia is Buell's 'Snow Queen.'

Genereux

mer. Blossoms come from November to April. Afterwards, dry off and leave the plants in dormancy and near dryness for several weeks until replanting time comes in summer.

Streptocarpus

Two good crops of bloom are possible with streptocarpus if seeds are sown in January or February and again in July or August. The Weismoor hybrids, which give especially fine flowers, bloom within a year from seed. For decoration in the greenhouse they vie with gloxinias. Flowers are similar—large, somewhat tubular, and of

purple, red or white. The leaf (there is sometimes only one on a streptocarpus) may be a foot long. The plants respond well to coolness at night—down to 50 degrees F. In winter they need several hours of sun each day.

S. saxorum is a very different and distinctive species. A late winter display of white and lavender flowers on trailing stems among many small leaves can be induced with sun, warmth and intense humidity.

All species of *Streptocarpus* may be carried over from one year to another in the greenhouse, and they will continue to increase in size.



Kohleria lindneriana

Achimenes 'Camillo Brozzoni'

Smithiantha multiflora nana

McDonald

Scaly, conelike propagules of several gesneriads. These small structures appear in leaf-axils after flowering. When placed in soil, new plants start in a short time.

SUCCULENTS

Cacti and other fleshy plants exact careful attention to soil and drainage

Claude Chidamian

THE succulents do not belong to any one family of plants. Although cacti are perhaps the best-known group, there are succulent species in about forty plant families. They derive their collective name from the Latin *succulentus*, which means juicy or fleshy, because they are all drought-resistant plants especially adapted to taking up and storing great quantities of water in their thick leaves, stems or branches.

Succulents are found in nature wher-

ever plants have difficulty getting and holding water. Most of them grow in desert areas, many in alpine regions, and some on sandy, saline shores and in crevices of cliffs overhanging the sea. A few kinds, mostly spineless ones, inhabit the moist tropics.

Cacti are the principal succulent plants of the American deserts; mesembryanthemums and the little stone- and window-plants (*Lithops*, *Conophytum*, *Pleiospilos* and others) form prominent parts of the



Simms

Potted cacti, some of them collectors' items, on a greenhouse bench. Cacti are slow in their demands for greater living space, for they are in active growth only a few months each year.

South African desert flora. American century-plants (*Agave*) and African aloës are larger inhabitants of these dry and rocky regions. Some of the sedums are alpine dwellers.

Rosette-forming species of *Dudleya* and *Echeveria* are found along the California coast. The bright-flowered kalanchoës seen at Christmas-time, the bryophyllums, which sprout new plants from leaf edges and tips, and species of *Rhipsalis* with leafless, cord-like stems are among the well-known succulents of moist tropical areas.

How Not to Grow Them

The fact that succulents are so well adapted to drought and hardship has led many gardeners to one or another false conclusion regarding their culture: either that better care will improve the plants, or that lack of attention is the secret of success. Actually, nature gives succulents very special care, particularly where soil and drainage are concerned. Too much kindness with fertilizer and water usually means sure death to them in cultivation. On the other hand, succulents do require moisture and mineral nutrients, but in the right amounts. Neglect of their needs will do them no good.

Soil Mixtures for Succulents

The potting soil for succulents should consist of equal parts of sand, soil and leaf mold for the desert, alpine and shoreline species; and the same with an added part of leaf mold for those of the moist tropics, sometimes called "jungle" species. Use only clean, coarse river sand, as fine beach sand packs hard and may contain salt or other impurities. The leaf mold should be well rotted and preferably from hardwood trees such as oak, but any good garden loam will do for the soil. These ingredients should be well mixed and coarsely screened to make a loose, friable, sweet-smelling compost.

Growers in very cool, damp regions may wish to add a half part more of sand or poultry charcoal or Perlite to make their compost even lighter and better drained. Those in hot, dry regions

may add as much soil and leaf mold to hold moisture. Some growers always add a light sprinkling of hydrated lime, crushed oyster shells, or limestone chips to the soils for any succulent with heavy spines or horny tubercles. Others add a light dusting of bone meal as a safe fertilizer in any mixture. The truth is that any and all of these formulas work, not because they are especially good in themselves, but because they all supply the three basic needs for the roots of succulents: good aeration, steady nourishment, and perfect drainage.

Pots and Potting

Most gardeners pot their succulents in porous clay pots, but glazed pots, plastic pots, wooden boxes or even tin cans may be used. Far more important than the kind of container selected is the size. Succulents that are underpotted or overpotted not only look unbalanced, but grow improperly. It takes a little experience and a handy rule of thumb to select the right pot for each plant. For plants of a rounded form use a pot one inch wider than the diameter of the plant. For tall-growing plants select a pot half as wide as the plant is tall.

Spiny succulents may be handled with stout leather gloves, rubber-padded tongs, or an improvised holder. One can be made by rolling several sheets of newspaper into a strap which is placed about the body of the plant with the two free ends serving as a handle.

Because succulent plants are susceptible to rot from excessive moisture in the soil, especially when their roots have been disturbed or cut, both the plant to be potted and the potting soil must be dry at the time of planting and kept so for several days afterward. Moisture should be applied very sparingly for the first month or two. Otherwise the process of potting succulents is the same as that used for other plants. Most succulents will normally require repotting once every two years.

Water for Succulents

It may seem strange that the first and



Kalmbacher

Succulent plants occur in varied forms. Shown here are *Haworthia curtisi*, a South African native; *Lampranthus*, whose flowers show it to be of the mesembryanthemum group; and *Echeveria potosina*, a rosette type of fleshy-leaved plant from Mexico.

most important requirement of these drought-resistant plants is water. Watering is one of the greatest problems of the beginner because he falls into the error either of watering his succulents as his other house plants or, knowing they are drought-resistant, failing to water them at all. Both extremes lead to loss of roots and eventual death of the plants.

It is almost impossible to tell how often any given succulent must be watered, for that depends on the nature of the plant's root system, its age, location, and the season of the year. Established plants making fresh growth in spring or summer can be watered as often as the soil dries out. They require far less water as the weather becomes cooler in fall and winter. During this period they should be watered only enough to keep them

from shriveling. A reliable rule is this: Water succulents thoroughly when they are growing, sparingly when they are dormant, and not at all when you are in doubt.

Rest Period

When succulents are dormant they want no coddling or disturbance—only rest. In a winter greenhouse they should be kept well ventilated and at a temperature of 40 to 50 degrees F. Very little food and water need to be supplied.

Their active season is rarely more than three or four months in duration. For several other months each year, succulents should be allowed to rest easily and naturally. They are essentially slow-living plants. When given the care they need, they are durable and satisfactory.



This curious succulent (*Fenestraria rhopalophylla*) is a "window-plant" from South Africa. It grows in a sandy soil mixture; should be watered sparingly. Available from Johnson Cactus Gardens, Paramount, Calif.

HARDY AND TENDER BULBS

*Selections for greenhouse
culture*

George B. Park

THE home greenhouse, the sunny window, shady window, even the fluorescent-lighted basement, can all be made bright and cheerful with the blooms of the bulbous flowering plants. Most are very easily grown; and on the whole they are more forgiving than most fibrous-rooted plants.

Inexperienced gardeners can grow bulbs successfully. My eleven-year-old daughter planted three varieties of calla in pots of sphagnum moss last winter, put them in her window and kept them watered. They have all bloomed nicely under her hand. She had absolutely no previous experience and no help except what she read in the direction sheet.

Some bulbs like full sun, others partial shade; some need a high temperature, others the medium temperature of a cool greenhouse. Bulbs that require special conditions beyond these are not included here. In common parlance the term "bulb" embraces also plants that grow from corms or rhizomes and others, including such fibrous-rooted plants as lily-of-the-valley, that are handled more or less like bulbs.

Bulbs for a Cool Greenhouse

Among the most easily grown bulbs are those that do best in a cool greenhouse. Most are available from dealers only in the fall. Among them are some of the hardy outdoor bulbs (tulips, narcissi, hyacinths, crocuses and others) which can be brought into bloom in the greenhouse long before they could flower in the open. Outdoors the cycle covers seven to eight months. Indoor forcing reduces it to about four months. Grapehyacinths (*Muscari*), snowdrops (*Galan-*



Park

Beady black centers glisten within each white flower of the Arabian star-of-Bethlehem (*Ornithogalum arabicum*). This species needs a warm greenhouse.

thus), glory-of the snow (*Chionodoxa*) and the similar-appearing *Puschkinia* are among the small hardy bulbs that can be successfully forced in the greenhouse.

Plant bulbs as soon as they are available, in an ordinary flower pot or bulb "pan" (another name for a shallow flower pot). The pot must be at least 5 inches high and have a drainage hole. Put a piece of broken clay pot over the drainage hole and add a few more pieces to permit a flow of water. Fill half the container with porous soil. (If the soil contains much clay, mix in sand to loosen it.) Place the bulbs on this bed of soil about half an inch apart. Add sufficient soil to almost cover the tops of the bulbs. Do not pack soil too firmly. Water thoroughly.

The bulbs are now ready for rooting, which requires darkness and low temperature (about 45°). A cool cellar or unheated garage will do as long as ventilation is adequate. Water the pots frequently enough to prevent their drying out. Rooting usually takes about two months. Top growth of hyacinths and



Grape-hyacinth (*Muscari*) is one of the outdoor bulbs that can be forced into early bloom in a greenhouse.



The tender Chinese sacred lily (*Narcissus tazetta orientalis*) will bring flowers and fragrance into the greenhouse long before the hardy narcissi bloom outdoors.

daffodils then should be about 1 inch high, that of tulips 2 inches.

When roots have developed, bring your bulbs indoors. Place them for one week in a dark area at a temperature of about 60°. Then bring them into full sunlight and water them daily. Small bulbs such as crocuses, muscari, etc. may be brought immediately into daylight, but a temperature of 50° is necessary. After the bulbs have flowered, try to keep the pots in a location which is not warmer than 65° at night. Many bulbs may be ripened and saved for planting another season.

Lily-of-the-Valley (*Convallaria majalis*)

Not a true bulb, but treated much like a bulbous plant. The familiar fragrant flowers are easily and quickly forced into bloom from dormant pips. Start them in sphagnum moss in a warm, humid, heavily shaded spot. When growth becomes 5 to 6 inches tall, move the plants into a cool greenhouse to extend their period of bloom.

Narcissus

The tender sorts of *Narcissus*—Paper-white, Golden Paperwhite and Chinese

sacred-lily—add delicious fragrance to the greenhouse. They are easy to grow. Let them form their roots in a dark place



Snowdrops (*Galanthus*) are excellent hardy bulbs for forcing.



Freesias thrive in a cool greenhouse.



Cape-cowslips (*Lachenalia*) blossom, according to planting dates, between December and May.

before bringing into the light for their leaves and flowers to develop. Make several plantings two weeks apart for a succession of bloom.

Colchicum

September-flowering colchicums, which are like over-sized crocuses, will blossom from the dry bulb without soil or water, but do best if potted normally.

Freesia

Freesias are delightful for their heady fragrance and the graceful beauty of their wandlike flower-stalks. They require constant coolness and abundant moisture. Provide supports so that the weak stems can hold the flower-spikes erect.

Ixia

Ixias like a sunny spot for flowering. Several corms may be planted in a pot and forced the same as hardy bulbs. Their brightly colored star-shaped flowers, lavender, yellow, or green in different species, last at least two weeks in a cool greenhouse.

Cape-cowslip (*Lachenalia*)

Pendent spikes of inch-long red and yellow flowers adorn lachenalias from December to May, according to the time of planting. Their gracefully drooping swordlike spotted leaves, to about a foot long, make them attractive for pots or hanging baskets. Culture is the same as for freesias.



Nerine, a bulb for a cool greenhouse, has striking red-colored blossoms in the fall.

Nerine

Nerines develop swordlike leaves during winter; these die down and the bulbs rest from May to August. Sturdy 18-inch stems then appear, bearing umbels of showy pink-to-scarlet flowers with strongly recurved petals and long stamens in clusters.

Arabian Star-of-Bethlehem (*Ornithogalum arabicum*)

Glittering black beadlike centers are prominent in the fragrant shining waxy-white flowers of the Arabian star-of-Bethlehem. Large umbels of bloom occur atop stiff two foot stems.

Scarborough-lily (*Vallota speciosa*)

The rounded clusters of rich scarlet lily-like flowers of the Scarborough-lily are produced on two-foot stems in summer and autumn. It has strap-shaped amaryllis-like leaves. Give it sun in the greenhouse.

Veltheimia

Densely clustered downward-pointing tubular flowers of rose and green clothe the top six inches of the sturdy spikes of *Veltheimia*, which rise two feet above broad, decorative, shiny green leaves. One bulb in a pot provides an easily grown, long-lasting plant, which may be kept growing year round.

Blood-lily (*Haemanthus katharinae*)

Large umbels of trumpet-like red flowers with prominent stamens present the appearance of a feathery sphere. The culture is simple. A mixture of sandy loam and fibrous peat, or just sphagnum moss by itself, may be used for potting, and the plants flower more freely when under-potted. For this reason, it is not necessary to shift them every year. As the bulbs grow and the roots increase, a weak solution of soluble fertilizer or manure water will stimulate and support growth.

Blood-lilies succeed best in a temperature between 50 and 60 degrees F. during the growing season. After flowering, it is important that they have a period of growth followed by one of rest. Normally, the bulbs are rested over the winter and started into growth again in spring.



Fancy-leaved caladiums are grown for their colorful foliage rather than for flowers. In a warm greenhouse they sprout within a month and remain in good condition about six months.



The blood-lily (*Haemanthus katharinae*) is a spectacular plant in a cool-greenhouse when its large globe of feathery blood-red blossoms opens. It blooms most satisfactorily when under-potted.

Bulbs for a Warm Greenhouse

Some of the most delightful bulbous plants for greenhouse or indoor growing are in the high-heat (70-75°) group. (Some persons grow these at 65-70°.) Most of them are best grown in full or partial shade. My favorites are described below. The bulbs are mostly available in late fall, winter and early spring.



Amaryllis (*Hippeastrum* varieties) should be watered and fertilized after flowering.

Fancy-leaved Caladiums (*Caladium* varieties)

The variegated leaves show crimson, scarlet, rose, yellow and green tones, and are veined, spotted and margined in contrasting colors. Their stalks arise directly from the tuber. The plants grow in any rich soil and have no enemies. Flowers are seldom produced.

Calla-lily (*Zantedeschia aethiopica*)

Calla-lilies, admired for the perfection of their waxlike white flowers and beautiful foliage, may be brought into bloom



The hardy Chinese orchid (*Bletilla striata*) can be grown outdoors at least as far north as Washington, D. C. In a warm greenhouse its long-lasting lavender flowers bloom over a long period.

at almost any time. Plant in a rich soil. Keep dark and only moderately moist until roots form, then give ample light and water.

Amaryllis (*Hippeastrum* varieties)

The Giant Dutch amaryllis, which are superior to any other strain, are charac-

The calla-lily (*Zantedeschia*) is simple enough in culture to be grown by a child.





Park

The butterfly-lily (*Hedychium coronarium*) is a tropical plant which can add great beauty to a large greenhouse when its fragrant flowers open. Water and fertilize amply.

terized by widely flaring, almost flat trumpet flowers 6 to 9 inches across, usually four on a stalk and of pure, solid tones of red. After flowering, they require watering and fertilizing to promote development of the leaves. After good leaf growth has been made, watering must stop, to encourage the leaves to die down. When they are repotted, one-third of the bulb should be above the surface of the soil.

Hardy Chinese Orchid (*Bletilla striata*)

This unusual plant bears 12-inch stems, each carrying seven or eight long-lasting purple flowers resembling small cattileyas. It is hardy and may be planted in light shade outdoors, or grown as a winter-blooming pot plant.

Amazon-lily (*Eucharis grandiflora* or *E. amazonica*)

Clusters of delightfully fragrant, dazzling white 3-inch flowers are borne on 2-foot stems. This is a choice pot plant, graceful and prolific of bloom. Culture

is the same as for amaryllis (*Hippeastrum*).

Butterfly-lily (*Hedychium coronarium*)

The butterfly-lily is a strong-growing, moisture-loving plant of great beauty. Its deliciously scented pure white flowers are shaped like large butterflies hovering above waxy tropical foliage. The plants need resting for two months after flowering, then should be given abundant water and liquid manure.

Begonias and Gloxinias for Christmas

Start stored tubers in September or early October in 6-inch pots of sphagnum moss. Use a south window or a greenhouse where a temperature of 65° to 75° can be maintained. When the plants are growing well, provide extra light. A fluorescent light or 60-watt bulb two feet above the plants will do. The total of daylight and electric light must be 14 to 16 hours a day. This day length will bring the plants into bloom when the holidays begin.

CAMELLIAS FOR WINTER BLOOM

Larger flowers and longer season are possible in a greenhouse

Claude Chidamian

ALTHOUGH camellias may be grown out-of-doors in mild climates, under greenhouse conditions they bloom earlier and longer, with larger, more perfect flowers than can be produced in the open. So it is no wonder that greenhouse culture of camellias is spreading today from the North and Northeast, where it is a necessity, to the South and West, where it has become a desirable luxury.

The conditions under which camellias are found in the wild give a clue to the culture that suits them best. In eastern Asia they grow naturally on rugged hill-sides, in thin woodlands, and in rich well-drained valleys. Throughout the year they receive abundant rainfall, 70 or 80 inches, and constantly high humidity. Although often covered with snow in winter and subjected to temperatures sometimes above 90 degrees F. in summer, there are no wide fluctuations in the

daily temperature. While camellias grow in a variety of soils, all of them are well drained because of their texture and their natural slope, and they are continuously enriched by a mulch of forest litter.

Culture

The basic requirements for growing camellias under glass are the same as for growing them successfully out-of-doors: partial shade, uniform moisture, high relative humidity, good drainage, even temperatures, and ample ventilation winter and summer. From November through the blooming season a day temperature of 45 to 50 degrees F. and a night reading of 35 to 40 degrees will produce the largest, finest, most lasting flowers. If the thermometer rises above 50 degrees in the daytime during the blooming season, aborted flowers and loss of buds may result. When in bud, camellias can even



*Courtesy of Robert P. Woltz, Jr.,
Texas Greenhouse Co.*

From the North, where the practice is essential, greenhouse culture of camellias has spread to the South and Far West, where it brings a longer season of enjoyment to the grower.



Graf

'Debutante,' with light pink flowers, is one of the ten choice varieties of *Camellia japonica* listed by the author.

stand below-freezing temperatures and still open perfectly. They cannot, however, be forced, as many other flowers can, to produce earlier or larger blooms by increasing the temperature.

After flowering, to stimulate new growth, day temperatures may be increased to 65 to 75 degrees F. and night ones to 55 to 65 degrees. The plants will require abundant watering at the roots and over the foliage, adequate shading, and a relative humidity of at least 50 per cent at this time. If camellias must remain in the greenhouse during the summer, they should be given all possible ventilation as well, but it is preferable to move potted plants out-of-doors after the first cycle of growth has hardened and all danger of frost is past. The pots should be placed in partial shade under

trees or in a lath house and allowed to remain until the buds begin to swell and frost threatens again in the fall.

Containers for Camellias

The Chinese were growing camellias in containers generations before the first potted specimens reached Europe. It is this remarkable ability to thrive and bloom in pots that has made camellias popular among greenhouse plants.

Camellias may be grown in nearly any kind of container if proper drainage is provided. Nurseries usually grow their plants in tin cans of various sizes, but hobbyists, for aesthetic reasons, more often choose wooden tubs or clay or plastic pots. Metal cans and plastic pots have the advantage of holding a more uniform moisture content in the soil; they are therefore particularly advisable for small plants.

It is possible to keep camellias in pots for many years. A standard 12-inch pot will easily accommodate a vigorous six- or seven-year-old camellia for five years. Then it should be moved up to a 16-inch pot, which will hold it for ten years, and finally a 20-inch for another ten years' growth. After spending 25 years in pots, the specimen will be ready for a 24-inch box.

Soil and Potting

Because camellias are grown in the same container for years, the potting soil must be very rich and carefully compounded. A good soil is made by composting equal parts of topsoil, coarse oak leaf mold and well-rotted cow manure, with a generous sprinkling of cottonseed meal between layers. No lime or composting chemicals should be used, because camellias demand an acid soil. After six months of composting, the soil should be mixed with an equal amount of dampened peat moss. To four parts of this mixture is added one part of granulated poultry charecoal or Perlite.

Potting may be done during either the flowering or the dormant season. It is best for the amateur to wait until his plants are truly root-bound before he

moves them up, and then he should shift them into containers four sizes larger than those in which they have been growing. For example, a plant being shifted from a gallon can (equivalent to a 7-inch pot) would go into a 12-inch pot.

Actual potting is done as follows: First place a large piece of broken crock, rounded side up, to cover the drainage hole. Over it place a layer of smaller pieces an inch or two deep. Then press an inch-thick layer of damp sphagnum moss on top of the crocks to prevent soil from mixing with them. Enough potting soil is then added over the moss so that the plant's root ball, when set in place, will reach to about an inch below the rim of the pot. Firm the new soil well around the plant. Finally, set the newly potted plant on gravel, bricks, or tile to keep the drainage hole free; then water the plant thoroughly.

Fertilizer

Camellias are by nature slow-growing plants that cannot be forced without disturbing their natural cycle of growth and bloom. Once they are properly planted, they are practically self-sustaining and need no food for a season or two. Container-grown plants, especially, should be fed sparingly. It is not the purpose of the greenhouse hobbyist to produce as large a plant as possible, but to maintain a plant in a healthy free-blooming condition while keeping its stature relatively small. In their native state camellias depend upon the decay of the woodland mulch for all their soil nourishment. Surprisingly, this analyzes only eight-tenths per cent nitrogen, three-tenths per cent phosphoric acid, and four-tenths per cent potash. Thus camellias should be given a very mild fertilizer. Well-rotted manure, manure water, or cottonseed meal should be used in light feedings several times a year rather than all at once.

Varieties to Choose

A single camellia plant can be a fine ornament in any greenhouse. Where

there is space for a collection, the following varieties of *Camellia japonica* might be called the "Big Ten":

Adolphe Audusson—an immense semidouble deep red which is also available in a brilliantly variegated form as 'Adolphe Audusson Special.'

Alba Plena—the finest double white; can also be had with petals fringed like a carnation in the variety called 'Fimbriata.'

Daikagura—outstanding red and white peony-form; a pale pink sport is named 'High Hat'; a white sport, 'Conrad Hilton.'

Debutante—a light pink peony-form, ideal for cutting and corsages.

Donckelari—a brilliant semidouble red and white; among its numerous sports, the fringed and fluted 'Ville de Nantes' is outstanding.

Elegans (Chandler) Variegated—the finest rose and white anemone-form; also available in pale pink as 'C. M. Wilson' or in white as 'Shiro Chan.'

Finlandia—large semidouble white with many sports, among them the red-streaked 'Finlandia Variegated,' red-marbled 'King Lear' and pink 'Monte Carlo.'

Glen 40—the perfect double red camellia; also variegated with white.

Herme—semidouble light pink, streaked red and bordered white; dozens of sports, including the rose, white-spotted 'Beauty of Holland,' the white-bordered rose 'Look-Away,' and pale pink 'Spring Sonnet.'

Mathotiana—a massive rose-form scarlet; also available in rich rose as 'Rosa Superba,' with fringed petals as 'Flowerwood' or in semidouble form as 'Mathotiana Supreme.'

For the advanced collector the large iridescent silken blooms of *Camellia reticulata* make several of its varieties desirable. Especially worth trying are the rose-pink semidouble 'Buddha,' crimson 'Butterfly Wings,' the orchid-pink 'Willow Wand,' the rich red 'Noble Pearl' or 'Crimson Robe' and the brilliant red and white 'Lion Head.'

PLANTS THAT CLIMB AND HANG

*Aerial space in greenhouse
provides room for
extra specimens*

Ruth Marie Peters

EVERY greenhouse gardener soon finds bench and shelf space overflowing. The only place to go is up, and he welcomes the opportunity for expansion offered by hanging pots and baskets and by trellises or other means of plant support. Climbing plants can help to soften harsh angles of walls and roof, and gracefully trailing stems studded with blossoms add color and interest above bench level.

Hanging plants may require watering more often than other plants, especially if they are growing in baskets of moss-lined wire or other type of openwork. Otherwise all the rules of bench-level culture should be followed in growing both climbing and hanging plants.

Vigorous specimens may need to be kept in check by regular pruning so they do not cast too much shade on the plants below. However, this shade can be an asset if it is purposely planned to shield sensitive plants from strong sun.

Many of the annual climbers grown in gardens in summer can be grown in a cool greenhouse (45 to 55 degrees F.). A few



Generous

Star-of-Bethlehem, or Italian bellflower (*Campanula isophylla*), is one of several campanulas that blossom abundantly in hanging baskets in a cool greenhouse.

of them have been included in the list that follows, but a nursery catalog of annual flowers will turn up many more. Indeed, part of the fun of greenhouse gardening is hunting out plants to try—not always new ones, but sometimes the familiar outdoor plants that will provide renewed fascination when we grow them indoors where we can observe them close at hand.

Here is a variety of plants that trail, creep, or climb, with brief descriptions and cultural tips:

***Achimenes*.** Trailing plant grown from tubers resembling small pine-cones. Flowers white, blue, lavender, purple, pink; some with orange and yellow tubes or throats. Warm night temperature, 65 degrees F.; filtered light, even moisture. See nursery catalogs for species and their many varieties.

***Asparagus plumosus*,** asparagus-fern. Dainty light-green trailer with fine needle-like leaves, small pink-white flowers that are sometimes followed by red fruits. Cool night temperature, 45 degrees F.; full sun or filtered light, and even moisture.

Begonia pendula, hanging tuberous begonia. Trailing stems; scarlet, yellow, white, orange, salmon, or pink flowers. Warm night temperature, 65 degrees F.; filtered light, constant moisture. Many other begonias with semitrailing stems can be used in hanging baskets.

Bougainvillea glabra. Woody climber that will grow up to roof rafters. Bright green leaves, purplish-pink flower bracts. Warm night temperature, 65 degrees F.; full sun. Dry out a bit between waterings.

Browallia speciosa major. Good trailing basket plant. 50 to 55 degrees F. at night, filtered light, even moisture. Small leaves, bright blue flowers with white throat. Almost everblooming.

Campanula isophylla, star-of-Bethlehem or Italian bellflower. Dainty trailing stems, small green leaves, white starlike blossoms. Cool temperature, 55 degrees at night; soil rich in organic material, bright light or full sun, even moisture. Similar campanulas include these: *C. clatines alba plena*, double white flowers; *C. clatines flore-pleno*, double lavender-blue flowers; *C. fragilis*, purplish blue flowers with white centers; *C. isophylla mayi*, hairy gray-green leaves and pale blue flowers.

Cissus antarctica, kangaroo-vine. Climbing or trailing plant with large glossy green leaves, fast grower. 50 to 55 degrees F. at night. Give plenty of water but let soil become almost dry between waterings. Several other species of *Cissus* are also useful. *C. adenopoda* climbs quickly on bark, has metallic sheen on leaves and is covered with purple hairs; *C. discolor* has leaves colored silver and violet, with dark red veins and stems. *C. rhombifolia*, grape-ivy, is an easy-to-grow small vine or trailer with light green leaves, hairy beneath. Young leaves are quite hairy.

Clerodendron thomsonae, glory-bower. Twining evergreen shrub to 15 feet or more with crimson and white blossoms. For warm greenhouse, 65 degrees F. at night; part sun, even moisture.

Cobaea scandens, cup-and-saucer vine. Climber, easily grown from seed. Large bell-shaped violet flowers. 55 degrees F. at night, full sun, even moisture.

Columnnea. Trailers of many kinds with

thick small leaves, orange, yellow, red, or purple flowers. Moderate to warm night temperature, 55 to 65 degrees F.; filtered light, even moisture.

Cyanotis kewensis, pussy-ears. Trailing or creeping plant with gray-green woolly leaves, violet-blue flowers. Moderate 55-degree F. night temperature, full sun, even moisture.

Episcia cupreata. Creeper or trailer, can also be encouraged to climb on support such as a "totem pole" (a length of tree-fern stem). Wrinkled leaves of metallic color and attractive markings. Flower orange-scarlet. Many varieties now in commerce: Aeajou, Amazon, Chocolate Soldier, Emerald Queen, Frosty, Harlequin, Silver Queen, all with attractively marked foliage. Give warm night temperature, 65 degrees F.; filtered light and even moisture.

Ficus radicans, trailing or creeping fig. Will climb on support or trail from hanging



Genereur

Silver and violet mark the red-veined leaves of *Cissus discolor*.

basket. Likes warmth—65 degrees F. at night, part sun or filtered sun, and even moisture. Other kinds are *F. r. variegata*, gray-green leaves marked with cream white; *F. pumila*, a small-leaved creeper, and *F. p. minima*, a miniature.

Fuchsia. Many trailing varieties: Cascade, Dollar Princess, Flying Cloud, Harvest Moon, Springtime. Many others listed in catalogs in white and a variety of rose, pink and purple tones. Give cool night temperature, 45 degrees F.; shade, even moisture.

Gloriosa rothschildiana, climbing glory-

Mottled leaves of gray-green and white make this climbing fig (*Ficus radicans variegata*) a distinguished plant for a warm greenhouse.

Generous



lily. Tuberous roots, leaves with tendrils at tips, red and gold flowers. Also *G. superba*, *G. s. lutea*, and *G. virescens*. All need warm 65 degrees F. at night, full sun, even moisture, and a rest period during which water should be withheld.

Hedera, English ivy. Ivies of the genus *Hedera* are a huge group. You could fill an average home greenhouse in no time at all with just one of each kind. They will trail, creep, or climb. Cool, 40 to 45 degrees F. at night, full sun or filtered light, average moisture. Refer to nursery catalogs or books for descriptions of numerous kinds available.

Hoya carnosa, wax-plant. Fleshy, waxy leaves, clusters of waxy white or pink-tinged flowers. Likes warmth—62- to 65-degree F. night temperature; full or lightly filtered sun. Sometimes slow to flower. Old flower spurs should not be cut off since these may furnish new bloom. Can be trained on a pot trellis or allowed to climb toward greenhouse roof.

Ipomoea, morning-glory. Annual that is easily grown from seed. White, blue, pink, or red flowers. Cool, 45-degree F. night temperature; full sun, even moisture. Blooms best when roots are confined.

Jasminum officinale. Climber with fragrant white blossoms. Give 55 to 65 degrees F. at night, full sun, even moisture.

Lantana montevidensis, trailing lantana. Small gray-green leaves, rosy-lavender flower-heads. Cool night temperature—40 to 45 degrees F.; full sun, soil dried out between waterings.

Passiflora caerulea, passion-flower. Climber with blue, white, and purple flowers. Takes a moderate temperature of 55 degrees F. at night; full sun, even moisture.

Pelargonium peltatum, ivy geranium. Trailing branches, flowers may be rose, salmon, red or white. Leaves five-lobed. Cool night temperature—40 to 45 degrees F.; full sun. Dry out between waterings.

Pellionia daveauana. Creeper or climber that has fleshy stems and small leaves of brown and pale green. 65 degrees F. at night, high humidity, part sun, and even moisture. *P. pulchra* is similar but with



Taloumis

Trailing lantana (*T. montevidensis*) demands full sun by day, cool air at night, to produce abundant flowers.

light-green leaves and dark-brown veins, purplish on reverse side.

Petunia. Many, like the balcony types, trail gracefully from hanging baskets. They can be raised easily from seed. Cool night temperature—45 degrees F.; full sun, even moisture.

Philodendron. This is a huge group of large-leaved plants grown mainly for their foliage. Many trailing or climbing types listed in catalogs. Require 65 degrees F. at night, filtered light, even moisture.

Saxifraga sarmentosa, strawberry-begonia or strawberry-geranium. Trailing strawberrylike runners, leaves silver along veins, purplish-pink beneath, small white flowers in panicles. 45 to 55 degrees F. at night; filtered light, even moisture.

Schizocentron elegans, Spanish-shawl. Dainty trailer, small leaves, red stems, magenta flowers. Needs 55 degrees F. at night, filtered sun, even moisture.

Scindapsus aureus, devil's-ivy. Climber or trailer. Often called "pothos" in commerce. Leaves are heart shaped, waxy green with yellow variegation. Marble Queen is blotched with white. Likes warmth—60 to 65 degrees at night. Part sun or filtered

light. Let soil dry slightly between waterings.

Sedum morganianum, burro-tail. An interesting hanging plant with blue-green succulent leaves in long cords; flowers are light pink. Needs 55 degrees F. at night, full sun, and likes to dry out a bit between waterings.

Stephanotis floribunda. Wiry climber with wax-white, perfumed flowers. Likes 65 degrees F. at night, full sun, even moisture.

Thunbergia alata, black-eyed-Susan vine. Climbing vine easily raised from seed. Flowers cream, yellow or orange with purple throat. Give 65 degrees F. at night, full sun, even moisture.

Tradescantia fluminensis, wandering-Jew. Green or white-and-green leaves. Grows rapidly and trails or creeps and is good for hanging baskets. 55 degrees F. or more at night. Grows in almost any soil in sun or shade. Needs plenty of moisture.

Zebrina pendula, inch-plant. Striped foliage, purplish-green leaves, small red-lavender flowers. Same requirements as *Tradescantia* (above). Other forms are variously striped and marked with green, white, and purple.

Monstera deliciosa is a high-climbing vine for a large greenhouse. In its juvenile stage, before its leaves show many of their characteristic lacerations, it is erroneously known as "Philodendron pertusum."



BONSAI IN A GREENHOUSE

Elizabeth N. Hume

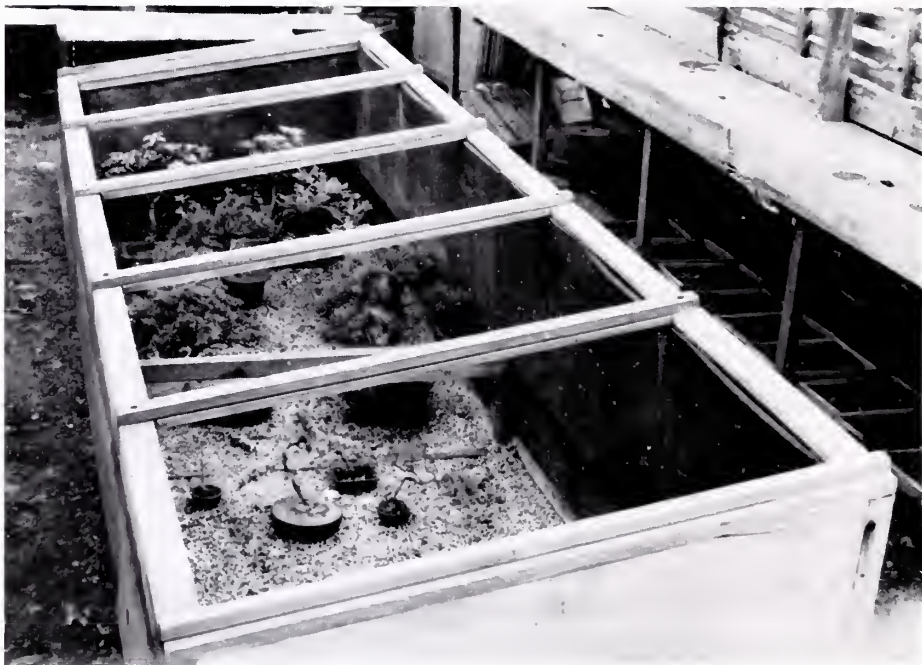
NOT the least of Japan's gifts to the cultural world is the gentle art of bonsai; and happily I am one of many of its ardent followers. As in most hobbies restraint is often the victim of enthusiasm, and in bonsai particularly, there is the irresistible urge time and time again to make room for "just one more." How then to plan for year-round enjoyment of a modest collection and for the "pre" and potential bonsai assemblage that is part of it?

Working Up to a Greenhouse

In the early stages our sunny windows coordinated seasonably with the coldframe to over-winter the original plants. It was indeed a consuming interest—poring over

and pampering each and every promising acquisition. Many were tender bonsai, and never left the house, but the deciduous material and all of the needle evergreens took their chances in the frame. It was learning the hard way those years, and I soon realized that a more adequate set-up would be needed if I were to continue.

Advancing from the coldframe phase we laboriously prepared a sunken pit—shored up with timbers, lined with building paper and covered tightly with a frame to which plastic screening had been applied doubly for insulation from the outside winter cold. Damp sawdust, into which we sank the larger bonsai in the sunken pit right in their containers,



Buhle

Wintering bonsai in a deep coldframe is one way of protecting them during the cold months. Double plastic-covered sash are fitted over the top. Side walls are insulated.



The author's greenhouse is devoted chiefly to bonsai.

Crew Studio

provided winter quarters for all that I had to store, and all emerged strongly budded and bursting with life the following spring. Collections of mosses and lichens in flats delighted in their underground "coolth." I would have kept the pit but for its unattractive exterior and the inconveniences entailed in working it.

At last (and well worth the wait) we have evolved a better solution without the drawbacks of the pit. A semi-attached twin greenhouse has been installed over the pit and coldframe area. We can look into it and through it from the kitchen windows only 14 feet away. I can now enjoy the double attraction it affords, for from Christmas on there is a modicum of bloom in the warm half, backed by a young forest of bonsai trees (mostly evergreens in cold storage in the unheated section). It is indeed a lovely sight on a cold winter's day and the more so when sparkling snow and colorful birds add their interest to the scene.

Bonsai For the Warm Greenhouse

The warm half provides fragrance as well. A favorite bonsai of *Daphne odora* blooms in February, followed by the highly scented dwarf Natal-plum (*Carissa grandiflora*). A twisted old rosemary, blue with blossoms, seems constantly in need of pinching, and its pungency is long remembered. *Gardenia jasminoides* (*G. radicans*) sets buds and blooms early if the sun urges it, and its perfume pervades the greenhouse. A 50- to 60-degree setting would seem too cool but evidently it is not. It is cool for the delightful little malpighias (*Malpighia coccigera*) and the dwarf pomegranates (*Punica granatum nana*) but they mark time for April. The low temperature range is fuel-saving, too, and holds plant pests and diseases to a minimum. Now with ingenuity and forethought many plants can be either held or forced according to whim or deadline date.



Crew Studio

One end of the author's cool greenhouse. The three large bonsai on the top row, left to right, are Alberta spruce, Hinoki cypress and rosemary. Other species in the picture include *Cotoneaster microphylla*, *Ilex crenata helleri* and variegated true myrtle.

The Cold Greenhouse

Designed for the coldest non-freezing temperature the weather outside will permit, the cold storage section provides dormancy with protection. Granted there may be a greater surge of the "vernal urge" in the rugged outdoor specimen, the ideal is to balance winter safety with the opportunities of controlled temperature, light, ventilation and humidity. The preservation of the moss and underplanting which to me is often the main delight of a bonsai, is still another factor favored by the coldhouse. I find each greenhouse a welcome addition to the other and admit to no favorite.

Occasional Greenhouse Problems

Pitfalls? We have encountered surprisingly few. Automatic though it may be, a glasshouse must be watched and checked regularly. Our only close call last winter was a heavy build-up of snow and ice, weighting down the ventilating windows

and rendering them inoperable. We did have to spend the greater part of one day using poles to chip the ice, and raised the inner temperature to 90° to melt what we could not otherwise remove. The chipping was fun, but glass is glass and we were lucky.

Storms do wreak havoc occasionally and we keep a stand-by kerosene stove handy in the event of power failure, for without electric power the gas heater can not operate, and it is conceivable that the vents might be caught in an open position, in which case losses could very well occur.

Assets, advantages and pitfalls aside, my bonsai beckon. Some need a light spray only, some need drenching, some need pinching, some need pruning. Some are inside, some are outside. Wherever they are, they need me; I needed the greenhouse, and now I have it and all the joys and satisfactions that go with it. I need not say more.

GROWING ORCHIDS RIGHT AT HOME

*Greenhouses
simplify culture for
the amateur*

R. I. McLellan



ORCHIDS do extremely well in the modern glasshouse. Given proper conditions, they require much less care than many other plants. Even if an ideal environment cannot be provided, it may prove rewarding to experiment with growing different kinds, for orchids will tolerate wide variation from the growing requirements here described.

Although there are more than 20,000 different kinds, when orchids are mentioned the image in the mind of most people is of the large-flowered cattleyas. Cattleyas will therefore be the principal group discussed here, with references to other kinds for home greenhouse culture where appropriate.

Location

Many orchids—especially those having pendent flowers—may be hung from the wall or ceiling, thus utilizing space that is often wasted in the ever-crowded glass-

house. Otherwise, they should be placed on a bench affording good air circulation, drainage and light. Avoid forced drafts. If seedlings or other very young orchid plants are being grown, the part of the greenhouse with most heat, most shade and highest relative humidity should be selected—even more warmth and humidity than is required by the warm-growing types.

Humidity

Most orchids respond well to a moist atmosphere. Ideal conditions are 50 to 70 per cent relative humidity, which is somewhat higher than many other plants require. To obtain this, if automatic humidifying sprays beneath the benches are lacking, the floor under the benches may be covered with a thick layer of coarse gravel which, when wet down, will permit the moisture to evaporate gradually into the air. The time to wet the



The Staggs

Cymbidiums, if given abundant watering and feeding, are not difficult to bring into bloom, and the flowers are long lasting.

gravel is from morning until mid-afternoon; night humidity is nearly always adequate. The higher the temperature, the more added humidity is necessary, particularly with warm-growing orchids and seedlings. During dry hot windy weather in summer and periods of severe cold in winter when artificial heat dries the air, a second daily wetting of the gravel floor may be necessary.

Watering

When watering orchids, water abundantly, applying water to the tops of the pots in excessive amounts, so that it floods through the pots with far more water draining out than is retained. The tips of your fingers, forced beneath the surface of the growing medium, will tell you whether the plants are thirsty. If the feeling is dry or harsh, water is needed. The coarser potting mixes, such as coarse bark, require more frequent watering because of greater aeration.

Young seedlings, being in small pots which dry out rapidly, also need to be watered often.

Cattleyas and related genera (as laeliocattleyas and brassolaeliocattleyas), plus oncidiums, miltonias, and odontoglossums, have thick aerial roots and also pseudobulbs (the swollen part just below the leaf), both of which act as built-in water tanks. This group likes a thorough drying out between waterings. Once a week is a good average for them, but watering may be increased to two to four times weekly in the heat of long midsummer days. On cold dark winter days (if the plants are not dried out by artificial heat), watering may be decreased to once in two weeks.

Another type of air-rooted orchid, represented by the phalaenopsis and vanda, has no pseudobulbs for water storage and thus requires more frequent waterings. The root area of these plants should be kept damp, but not saturated, at all times.

The cypripediums (*Paphiopedilum*) represent a third type, most of which are terrestrial orchids. These have no pseudobulbs or aerial roots; instead they have true roots which penetrate the growing medium. They are wet growers, and may be kept dripping much of the time; their roots should never be allowed to dry out completely.

A fourth type of orchid is the newly popular cymbidium, which is semiterrestrial but has large pseudobulbs; its requirement is for frequent watering—the same as for the phalaenopsis.

Light

The light needed by orchids varies with day length, temperature and humidity. Between 1500 and 2500 foot-candles is the accepted amount for cattleyas. During the shorter cooler days of winter, more intense light is required than in summer. When heat and light become excessive, shade must be applied to the glasshouse to prevent burning of the plants. For most orchids this summer shade should reduce the light to about

1500 foot-candles just enough so that no shadow is cast in the glasshouse. *Cypripediums* and *phalaenopsis* require 25 to 35 per cent less light. *Cymbidium*s, after they have flowered, like almost full sunlight if excessive heat can be controlled.

Temperature

Most orchids adapt themselves reasonably well to temperature changes, if variations are for a short time only. Orchids that require medium temperatures, along with the cattleyas, include *epidendrums*, *miltonias*, *oncidiums*, and mottled-leaf *cypripediums*. The ideal range for these orchids is from 60 degrees at night to the upper 70's in the daytime. Slightly less warmth is needed in winter and slightly more is beneficial in summer.

Cool-growing orchids include *cymbidium*s, plain-leaf *cypripedium*s, and *odontoglossums*, which should be kept three to five degrees cooler than the cattleyas. Warm-growing orchids include the *phalaenopsis*, *vanda*, and *dendrobium*. These enjoy five degrees higher temperature than cattleyas both day and night.

Feeding

Those who would have the most luxuriant growth should feed their orchids frequently but lightly. A totally soluble plant food used at one-half the strength recommended for other pot plants is a safe formula to follow for most kinds. Such liquid fertilizer may be applied



The Staggs

Cypripedium, the slipper orchid (*Paphiopedilum*), is a favorite for cool greenhouse culture. Flowers are in soft tones of green and brown and yellow.

once or twice a month with regular waterings, either using a proportioner or measuring it carefully in a watering can.

*Cymbidium*s are heavy feeders and should be given the full strength suggested for pot plants. Orchids growing in leaf mold, soft brown fibrous *osmunda*

LIFE OF AN ORCHID. *Left to right:* Mature plant bearing a ripened seed pod. Seedlings 8 to 12 months old on a nutrient medium in flasks. Young plants 18 to 20 months old in a "community flat." Three-year-old plant in a 3-inch pot. Four years old in a 4-inch pot. Five years old in a 5-inch pot. Mature plant in flower in a 6-inch pot.



and other quick-decaying material should be fed more sparingly.

Potting

When the plant begins to grow over the edge of the pot or when the potting medium begins to deteriorate, it is time to repot an orchid. This will occur at about two-year intervals.

Osmunda fiber has long been a favorite potting medium for orchids. Other materials used are shredded bark (generally from coniferous trees), peat moss or leaf mold. Sometimes a mixture of two or more substances is used. Ordinary clay flower pots are generally considered best.

When repotting a cattleya, as an example for several other genera, trim off the shriveled and leafless backbulbs. If the plant is large enough, it may be divided to make two or more plants. This is done by cutting the rhizome with a pair of shears. Each division should have at least three pseudobulbs.

In potting, shape the root mass with a knife or pair of shears to fit the rear

of the pot. Remove all sour or decaying potting medium from the roots. Select a pot with large drainage holes and of a size to permit two years' growth without being disturbed. Try to keep the rhizome in a horizontal position, about an inch below the rim, and place the oldest part of it close to the edge of the pot, to allow maximum room for growth in the pot.

The way an experienced orchid grower places and packs osmunda when using it as a potting medium is a technique that should be observed at least once before doing it oneself. While the plant must be well supported by the fiber, its rhizome should not be deeply embedded.

Pack potting medium firmly about the roots, as in potting any ordinary plant. Leave one-half inch space at top of pot to aid in water retention. It is well to stake and tie newly potted cattleyas.

Orchids are comparatively free of many of the usual pests found on other garden or pot plants. If pests do appear, they are easily eradicated with modern sprays.

Dividing an orchid by cutting the rhizome with a large sharp knife. Shears may also be used. Each new plant should have at least three pseudobulbs.

Potting an orchid, holding the base of the plant in place with the left hand while packing the potting mixture firmly about the roots with the right.

The Staggs



ORCHID INFORMATION CHART*

<i>Genus</i>	<i>Type</i>	<i>Relative Humidity</i>	<i>Watering</i>	<i>Light (in Foot-candles)</i>	<i>Temperature Night Day</i>	<i>Potting Mix</i>
Cattleya and related genera	Epiphyte with pseudobulbs	50-70%	Moderate	1500-2500	58-62 75-80	Bark, tree fern, or osmunda
Epidendrum						
Miltonia						
Oncidium						
Cymbidium	Semiterrestrial with pseudobulbs	50-70%	Frequent	Summer, 3500 Winter, 1200	55-60 70-80	Bark mix (bark, sand, peat moss, redwood chips, etc.)
Cypripedium—plain leaf	Terrestrial without pseudobulbs	60-75%	Heavy and frequent	800-1500	55-60 70-80	Sandy mix (using bark or peat moss or leaf mold, etc.)
Cypripedium—mottled leaf	Terrestrial without pseudobulbs	60-75%	Heavy and frequent	800-1500	60-65 75-80	Sandy mix (using bark or peat moss or leaf mold, etc.)
Dendrobium	Epiphyte with pseudobulbs	50-70%	Moderate	1500-2500	58-65 75-85	Bark, tree fern or osmunda
Odontoglossum	Epiphyte with pseudobulbs	50-70%	Moderate frequent	800-1500	55-58 70-75	Bark, tree fern or osmunda
Phalaenopsis	Epiphyte, monopodial**	60-75%	Frequent	1000-2000	63-68 75-85	Bark, tree fern or osmunda
Vanda	Epiphyte, monopodial***	60-75%	Frequent	2000-3500	60-65 78-85	Bark, tree fern or osmunda

*These suggestions give latitude to indicate frequent wide ranges that can be employed to grow orchids under varying climatic and geographic conditions and in different seasons.

**Growing continuously from the apex of the plant, rather than from side branches.

INFLUENCE OF LIGHT ON PLANT DEVELOPMENT

H. A. Borthwick

PLANTS have several requirements for light. The most obvious is for food manufacture. The plants make all the food they need for themselves and all the food for all the animals in the world including man. Such a tremendous food-manufacturing enterprise requires an enormous amount of energy, which plants receive from sunlight.

Plants also use sunlight in less obvious ways to regulate such features of growth and development as flowering and seed germination. Very low energies are adequate, but the wavelength requirements are very specific. Red light is more effective than that of other colors. The differences in wavelength requirements of light for food manufacture and for control of flowering, for example, are so great that the two phenomena clearly operate through quite different light reactions.

Application of Artificial Light

Artificial light is often substituted satisfactorily for natural light. The kind of artificial light used and the amount required depend on the kind of plant, the purpose for which the plant is grown, and the circumstances under which the light must be used.

One important reason for using artificial light is for experiments that require precise control of environment. Such use requires high light intensity because the plants usually depend entirely on artificial light. Because of the high-intensity requirement, this use of light is expensive and therefore restricted mainly to plant experimentation or to production of crops of exceptionally high value.

A second reason for using artificial light is for plants grown in areas of limited natural light such as a basement or living-room window. Additional light is required to permit the plants to manufacture enough food for their normal

growth. It is possible to grow plants completely under such artificial light. For this purpose fluorescent lamps are well suited.

A third reason for using light is to regulate day-length and thereby control flowering and other growth phenomena. The intensity of light to control plant growth through modification of day-length is very low and therefore its use is commercially practicable. Probably its widest commercial use is in production of chrysanthemums throughout the year. The plants receive natural light throughout the day but require rather low-intensity light during part of the night.

Influence of Day-length

Daily duration of light and dark affects plants in several ways. It influences flowering of several kinds, including many in which man has special interest. Certain plants, the so-called short-day ones, flower only at times of year when days



HOLLY CUTTINGS. *Left:* Rooted in winter on natural days supplemented with 3 hours of incandescent-filament light in middle of night. *Right:* Rooted with no artificial light.



SPRUCE CUTTINGS. *Left:* Growth made with 8-hour days. *Right:* Growth made under continuous light.

are short. Soybeans, many weeds, poinsettia and chrysanthemum are examples. Others, the long-day plants, flower in midsummer, when days are long. They include beets, spinach, wheat, oats and barley. Still other plants, such as bean and tomato, are relatively uninfluenced by day-length. They are called indeterminate.

Day-length also influences many other features not directly related to flowering. Long days cause onions to form bulbs, for example, and short days prevent them from bulbing. Long days of summer promote runner formation in strawberries. Short days do not, but they promote flower-bud initiation. Many woody plants cease growth and become dormant in winter even in the greenhouse, where temperatures are warm. If the days are lengthened with low-intensity artificial light, growth of many of those woody species continues indefinitely.

Other plant responses controlled by light but not by day-length include seed germination and production of anthocya-

nin and other plant pigments. Seeds of many varieties of lettuce, for example require light to germinate. Some lettuce seeds are so sensitive that less than a second of light induces germination. Many weed seeds germinate only when they receive light. For this reason they may remain buried for years without loss of viability. They germinate only when cultivation brings them into the light at the soil surface.

The color of the fruits of some tomato varieties depends on whether they were ripened in light or darkness. Fruits ripened in the dark are pinkish, whereas vine-ripened ones are orange-red. The difference is due to a yellow pigment produced in the skins of light-ripened tomatoes but not in the dark-ripened ones.

The same light reaction is involved in all these responses. The day-length control of flowering, the light control of seed germination, and the light regulation of the color in tomato skins are all induced by red light. Doubtless many other phenomena will be found responsive to the same light reaction.

Adjusting Day-length for Flowering

The daily duration of light is different in different latitudes and undergoes regular seasonal change. On January 1, for example, the periods from sunrise to



PETUNIAS. *Left:* Growth on an 8-hour-day schedule. *Right:* Growth on a 16-hour day.

sunset are about 10½ hours in Miami, 9½ hours in Washington, D. C., and 8½ hours in Seattle. On June 1 these light periods are 13½ hours in Miami, 14½ hours in Washington, D. C., and 15½ hours in Seattle. The desirability of using additional light at night thus depends on the latitude and time of year as well as on the kind of plant. If light is used to delay flowering of short-day annuals, it should be applied as soon as the seedlings emerge.

Some commonly grown short-day annuals are cockscomb, cosmos, gomphrena, marigold, salvia and zinnia. Better transplants are obtained by growing these with additional light at night to keep them in a vegetative condition until transplanting. Conversely, seedlings of long-day annuals such as petunia, aster, bachelor's-button, calliopsis, forget-me-not, phlox, rudbeckia, salpiglossis, scabiosa, snapdragon and verbena are of better quality if grown on 8- to 10-hour days during the early stages. To do this during periods of long natural day one must put the plants in complete darkness 14 to 16 hours per day. This is done by transfer of the plants to a dark room or by covering them in the bench with black cloth or building paper. Complete darkness, not shade, is essential, and treatment should start at the time of seedling emergence.

For supplemental light, both incandescent and fluorescent lamps are suitable sources. Incandescent-filament lamps are preferable when day-length control alone is needed. If additional energy for photosynthetic requirements is involved, fluorescent lamps are a good source, but for many plants a small amount of incandescent light added to the fluorescent results in more satisfactory growth.

Important advances in understanding the light reactions of plants have been made since about 1950.* A blue protein called phytochrome has been found to be the active agent in light absorption. In light it undergoes reversible change from one form to another, and one of the two forms is the active agent that controls plant responses such as flowering, seed

germination, pigment formation and growth. This biologically effective form of phytochrome is probably an enzyme, but its action is not yet fully understood. It seems safe to predict, however, that further advances of great importance to horticulturists will be made in the near future.

*For further reading on the subject, see the following references:

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CHRYSANTHEMUMS. *Left:* An 8-hour day. *Right:* Vegetative growth but no flowering on a schedule of 16-hour days.





Courtesy of Lord & Burnham

CHRYSANTHEMUMS AT EVERY SEASON

*Control of light and darkness in the greenhouse
brings plants into bloom whenever wanted*

Cornelius Ackerson

FOR a diligent amateur greenhouse gardener, the chrysanthemum is able to give a greater floral reward for the energy spent than almost any other flower. This is because with today's understanding of the chrysanthemum's requirements of relative darkness and light, plants can be brought into bloom in winter, spring or summer, as well as during the normal autumn season.

The chrysanthemum is a short-day plant. That is, it will bloom only after it has received the stimulus of a certain number of days in which the dark period exceeds the light period. In the North Temperate zone such conditions prevail in the fall, so most chrysanthemum plants will normally bloom in October or November. In a greenhouse, however, day-length can be artificially altered by shad-

ing on long days in summer or lighting during the short days of winter.

Commercial growers have developed procedures for lighting and shading which will produce chrysanthemum blooms at any season. A system that provides 7 to 10 foot-candles of light will prevent bud formation, while a complete shade that lengthens the night hours will induce bloom. The owner of a home greenhouse can easily adapt these methods to his own growing space.

One 75-watt incandescent light bulb in a large industrial-type reflector fixture will provide sufficient light for 25 square feet of bench area. The light period is best controlled by an inexpensive time switch which turns the equipment on about 10 p.m. and off about 2 a.m. This
(Continued on page 96)



EPIPHYLLUMS FOR GREENHOUSE COLOR

*Flowers of this showy group
of spineless cacti
make a vivid display*

Gertrude W. Beahm

Epiphyllum flowers are large, delicate of texture, and colorful. This one is 'Native Dancer,' apricot-orange with a gold sheen.

RICH colors and tremendous size are dominant qualities of epiphyllum flowers. When these cacti bloom on their flattened, leafless stems in spring, a collection of hybrids may exhibit flowers of pure white, pink, orchid, lavender, deep purple, red, copper, orange, amber, yellow or cream. Some of the violet-purple blooms have an iridescence that gives highlights of blue.

Flowers range from 2½ to more than 10 inches in diameter. The smaller-flowered varieties such as 'Deutsche Kaiserin' and 'Rosetta' often set buds in great quantities along pendent branches. These usually open toward evening, gradually revealing their vibrant colors as they slowly expand during the night. Large-flowered varieties seldom develop as many blooms. Some epiphyllums open by day.

Cultural Suggestions

Routine care consists chiefly of giving them a partially shaded location and watering them thoroughly after they have been dry a few days. Repotting is not

necessary every year; in fact, they seem to flower better when slightly potbound.

Although the culture of epiphyllums is simple, it is entirely different from that of desert cacti. Lack of this knowledge has caused many failures by those who have tried to treat them as ordinary cacti. Epiphyllums prefer the sort of filtered light that is suitable for most greenhouse ferns and begonias. Since the hybrids have received part of their inheritance from an epiphytic type of cactus—one which lives in trees—the potting soil must be open enough to allow rapid drainage of surplus water and free access of moist air.

A good potting soil can be made up of the following ingredients:

- one part well-decomposed leaf mold
- one part a compost made up of equal parts of
 - coarse gravel
 - garden loam
 - well-rotted steer manure

When ready for use, add about a teaspoonful of bonemeal to a 4-inch pot.

Do not use fertilizers heavy with nitrates. The soil should be neutral, the pH ranging from 6.5 to 7.5.

In hot or dry sections, peat moss and Sponge Rok are valuable additives as they help to keep the soil mixture from drying out too rapidly. In areas where there is much moisture in the air, avoid such water-retaining materials.

Transplanting Precautions

Care is always needed when transplanting to see that the potting mixture is only slightly moist and that the plants are not set too deeply in the soil. It is also important that the plants not be watered for a week or more after repotting. This precaution will prevent rot from entering any broken roots. Even if plants are not watered for two or three weeks, provided they are kept in a cool shady place, nothing but good will result. Like any other cactus, when their roots have been disturbed, epiphyllums require a time of readjustment before they are ready for water. Keep the soil at least an inch below the rim of the pot; this allows for the addition of fresh potting mixture from time to time.

Benefits of Pruning

Epiphyllums that grow too large can be pruned to great advantage. Older branches may be trimmed back to any height desired above two feet, the ends of the branches being merely rounded to make them look more natural. Flowers will develop from the lower areoles. These are the regions, in members of the Cactus Family, which correspond to leaf-axils in other plants; in most cacti a cluster of spines develops at this point. Epiphyllums, however, are spineless cacti whose broad flat or three-angled branches function as leaves. When tips of branches are injured or pruned, growth will be checked at that point; this will often force more branches to form at or near the base.

Exposure and Light

In sections where winters are severe, epiphyllums should be kept in an east,

south, or west exposure and watered sparingly during the cold winter months. Plenty of light during the winter helps the formation of buds for spring; keeping them in the dark seems to hinder the setting of buds. The time of flowering depends to a great extent upon day-length. Those plants in darker or more shaded situations come into flower much later than those that receive maximum light.

As soon as danger of severe frost is past, epiphyllums may be moved outdoors to a shady location sheltered from sharp winds. Here the buds which started to form earlier indoors will have a chance to develop. (In milder climates, unless there is danger of temperatures lower than 28 degrees F., epiphyllums may be left in warm, sheltered portions of the garden for the entire year.) The plants enjoy free circulation of air and as much light and warmth as possible, but direct sunlight may damage them.

Propagation

Epiphyllums are easily propagated from stem cuttings, each of which should have an areole. They may be rooted in sand in a slightly higher temperature than the mature plants require. Seed may also be sown, but it will not germinate if freshly ripened. Cuttings are generally simpler.

Winter Flowering

In a greenhouse with controls for light, humidity and temperature, epiphyllum flowers may be produced at seasons other than early spring. Varieties known to have a leaning toward winter flowering include 'Poinsettia,' bright clear red; 'Padre,' a pink trumpet; 'Baroness Marie Louise,' apricot-orange with darker center; 'Flamingo,' golden-orange with cerise edge; 'Mauvette,' pink-lavender, and 'Lydia,' signal-red, to name but a few.

There is a wide price range in epiphyllum plants. A high figure simply means that a variety is new or in short supply. Lower-priced varieties may offer as much beauty as higher-priced ones.

ANNUALS IN THE COOL GREENHOUSE

Alys Sutcliffe

FRAGRANCE and color can be added to the greenhouse in winter through the indoor culture of annuals. These plants that are grown from seed will also provide cut flowers for the home.

One advantage of these winter flowers is that they do not need much heat. A temperature of 40 to 50 degrees at night, with a slight rise in the daytime if the sun is up, is ideal for strong healthy growth.

Fresh air, when the temperature is above freezing, is essential. All annuals resent a close, damp atmosphere. Under this condition insects and diseases multiply alarmingly. A close watch must be kept to outwit such pests with sprays and dusts. There are several nontoxic materials on the market which may be safely used.

The nature of the soil in which seed is to be sown is important. An old standby consists of 1 part soil, 1 part peat moss or leaf mold, and 1 part sand. This should be thoroughly mixed and sterilized by steam, baking, hot water, or chemicals.

A mixture that has recently been tried out successfully by some Agricultural Experiment Stations is as follows:

- 1 bushel of peat moss
- 1 bushel Terralite #2 (vermiculite)
- $\frac{3}{4}$ pound pulverized dolomitic limestone
- $3\frac{1}{2}$ oz. superphosphate
- 1 pound 5-10-5 chemical fertilizer.

These ingredients must be thoroughly mixed and moistened; smaller or larger quantities in these same proportions may of course be put together. The advantages of this combination are that it is light to handle, it does not need to be sterilized, and the ingredients are easily stored in separate containers. When



Gantner

Snappedragons are among the most satisfactory of annuals for off-season culture in a cool greenhouse.

plants are to be moved into pots, the same mixture may be used with $\frac{1}{3}$ sterilized soil added. For many other plants, too, this would make a lighter and better drained soil than is ordinarily used.

Most annuals for the winter greenhouse are best grown in a coldframe until cold weather. This will prevent their becoming too thin and spindly.

Feeding of flowering plants with one of the complete fertilizers on the market may be done every two weeks. Follow the directions exactly, and never use more or make a solution stronger than the di-

rections advise; it is better to err with too little than too much.

In the following short list of annuals for greenhouse culture suggestions are given for fertilizing as well as for seed-sowing and general care.

Calendulas (often known as pot-marigolds) are good annuals for winter bloom. Sow the seeds in August. When the seedlings are ready to be transplanted, put four plants in a 5-inch pot. They make good cut flowers but take up quite a bit of room. They are subject to mildew; to control it, dust them with sulphur. Fertilize with super-phosphate.

Dwarf marigolds (*Tagetes*) may be sown almost any time in the fall. They will come into bloom in about six weeks. As the days grow shorter, flowers take longer to bloom, unless extra lighting is made available.

Mignonette (*Reseda odorata*) seeds should be sown in 4- or 5-inch pots in which they can flower. Mignonette does not like to be transplanted; it is better to thin out the seedlings, leaving six or seven plants to a pot. Flowers are not spectacular but they

are very fragrant. It is nice to add a stem or two to other cut flowers.

Petunias will flower readily in the small greenhouse. Seed of the upright varieties—plain, ruffled, or double—make attractive pot plants. Seeds should be sown in August.

Schizanthus, with its orchid-like flowers, is known as the "poor man's orchid." It is easily raised from seed to flower in the winter in a cool greenhouse. Seeds should be sown in August and seedlings transplanted when they are large enough to handle, in late September or October. Pinch twice before the end of October to make compact bushy plants. Do not overfertilize; give only a weak application occasionally.

Snapdragons (*Antirrhinum*) are good annuals for winter cut flowers. Sow the seed in August for winter bloom. When the seedlings are ready for transplanting, put four in a 6-inch pot or box. Pinch back when the plants are 4 to 5 inches high. When they are grown to a single stem, without pinching, to make long spikes for cutting, the side shoots should be cut out until the main stem has flowered.

Stock (*Mathiola incana*) sown from August through September may be potted up, a few at a time, to flower at Christmas and through February. Stocks are so sweet-scented that one needs only a pot or two to fill the greenhouse with fragrance.

Sweet peas should be sown in June for flowering from September through December. Later sowings, from August through November, may be made for winter or early spring flowering. Sow six or eight seeds in an 8-inch pot or box. Take out the weakest plants, leaving four of the strongest to continue growing. Wires or a trellis should be fixed to the pot as soon as the young plants appear. Sweet peas climb by tendril-bearing leaves and, like all climbers, will not grow well without adequate support.

Wallflower (*Cheiranthus*) is very fragrant and, with its deep red or yellow flowers, makes an excellent plant for a cool greenhouse. Sow the seed in July. When the seedlings are 2 inches tall, put them, four together, into a 5-inch pot. Wallflowers need a rich soil.

Calendulas provide fine blooms for cutting when grown in a cool greenhouse in winter.

Gantner



FOLIAGE PLANTS FOR THE WARM GREENHOUSE

Leaves can be as decorative as flowers

Frank S. Curto

THE ornamental qualities of the leaves of many tender plants give them a value equal to that of plants grown especially for their flowers. After they have been brought to some semblance of maturity in the greenhouse, they can be used for decoration in the home.

Suggestions for Culture

The cultural requirements for the average foliage plant in a greenhouse are relatively simple. Most of them grow best when given a night temperature between 60 and 65 degrees F. with a rise of 10 to 15 degrees on bright sunny days and about 5 degrees on cloudy days. Ventilation needs attention at all times, primarily to avoid drafts. Except when high winds or storms occur, abrupt changes in ventilation should not be made.

Since the majority of these plants are from humid regions, the air should be kept moist. In the North the plants should be shaded from direct sun from April until early October. During the winter months, the glass above them should be clear.

A compost with a high organic content is best for foliage plants. At least one-fourth of its volume should consist of peat moss or leaf mold. If the soil content of the compost is particularly heavy, Perlite or vermiculite will help to loosen it.

Guard against excessive use of fertilizers. It is seldom necessary to feed foliage plants until they have become well established in their final pots. Even then use fertilizer sparingly. Once the plant has attained a desirable size, effort should go toward maintaining it in good condition at this size, rather than stimulating it into excessive growth.

All photographs by Alfred Byrd Graf



Flowering-maple (*Abutilon hybridum*) makes a good specimen plant. Propagated by seed or from cuttings taken in February.



Amomum cardamon is an aromatic plant resembling the true cardamon.



Ardisia crispa holds its red berries and dark foliage well. It flowers on two-year-old wood.



Norfolk-Island-pine (*Araucaria excelsa*) is reproduced from cuttings of terminal shoots.

More foliage plants have been destroyed by inept watering than any other cultural practice. Unfortunately, precise directions for watering cannot apply equally to all growers, for no two would have identical environments for their plants. Even the time-honored suggestions of tapping the pot, feeling the soil, lifting the pot, and so forth, leave much to be desired. Techniques for determining the moisture conditions of a soil ball cannot be learned without experience. Judgment in watering can be acquired only through the actual growing and observation of plants. Meanwhile, suffice it to say that when foliage plants are watered, they should be watered thoroughly. Allow the soil ball to become slightly on the dry side before watering again.

Propagating Foliage Plants

Nearly all foliage plants are readily propagated by vegetative means, such as cuttings. An area in the greenhouse can be set aside for this purpose, its size determined by the grower's needs. Use a sloping case enclosed on four sides and cover it with either glass or plastic removable sash. If bottom heat can be provided by electric cables or by a position above heating pipes, propagation will be speeded. An enclosure as described will maintain a higher temperature and a higher relative humidity than are normally found in the open greenhouse. The media in which to propagate

foliage plants are sphagnum moss or a mixture of peat moss with Perlite, vermiculite or sand.

Keeping the Plants Healthy

The common pests of foliage plants are mealy bugs, scales, spider mites, aphids, thrips, slugs and various leaf-spot diseases. The insects are readily kept under control by most of the all-purpose insecticides currently on the market. Routine spraying will normally keep the plants free of pests. If a single plant becomes heavily infested, it should be removed from the greenhouse area and destroyed—unless it is a particularly valuable specimen. One badly infested plant often serves as a focal point from which the pest spreads to all the plants in a greenhouse.

When foliage plants are removed from a greenhouse and placed in a home, they occasionally become heavily infested with insect pests. Do not return such a plant to the greenhouse for "hospitalization." It is far better to destroy it than to risk infesting others by trying to nurse it back to health.

Plant diseases are difficult to control, once they have attacked foliage plants. Infected portions of plants should be cut away and immediately destroyed, preferably by burning. The plants should then be isolated and sprayed or dusted with some such fungicide as Captan or Ferbam.

MORE
FOLIAGE PLANTS
FOR THE
WARM
GREENHOUSE



Brassia (Schefflera) actinophylla has long-lasting glossy leaves. Outdoors in the tropics it becomes a tree.



Polyscias (Aralia) guilfoylei victoriac has lacy white-margined leaves. Easily grown from cuttings.



White-striped foliage distinguishes *Alpinia sanderac* from other members of the Ginger Family.



The holly fern (*Cyrtomium falcatum*) will stand abuse.



Creeping fig (*Ficus pumila*).



Polyscias (Aralia) balfouriana is easily propagated by cuttings.



'President'—one of many strikingly colored varieties of *Begonia rex*.



Bird's-nest fern (*Asplenium nidus*) thrives with occasional mild liquid fertilizer. Do not repot often.



The Hawaiian ti-plant (*Cordyline terminalis*) has numerous red varieties, such as 'Firebrand.'

GREENHOUSE FOLIAGE PLANTS

(continued)



A Boston fern (*Nephrolepis exaltata bostoniensis compacta*) with a growth habit suited to the small greenhouse.



Fittonia verschaffelti argyrea needs shade and high humidity.



Velvet-plant (*Gynura aurantiaca*) needs strong light.



Dracaena godseffiana is low growing. Propagated by layering.



The calatheas are attractive ground-cover or pot plants for the warm greenhouse. Left: *C. warcewiczii*; right: the zebra-plant (*C. zebrina*).

Podocarpus macrophylla withstands rugged situations in shade or sun. Easily grown from seed.





Holmes Nurseries

BROMELIADS

In flower and foliage, these epiphytic plants provide striking color and design in the warm greenhouse

Victoria Padilla

ALTHOUGH for over a century bromeliads have been favorites as decorative plants in continental Europe, they

are still relatively unknown in the United States. This seems strange when one considers that bromeliads are native only to



Padilla

Tillandsia cyanea, with bright rose bracts in geometric design, has large three-petaled violet-colored flowers.

the warmer regions of the Americas and are commonly seen in the flower markets of Latin America.

Everyone is familiar with two members of the Bromeliad family (which numbers almost 1900 species)—the edible pineapple and the ubiquitous Spanish-moss of our southern states. Many also know the "friendship plant" (*Billbergia nutans*), popular in the temperate sections of the country for its hardness and graceful, colorful, pendent flowers. But too few plantsmen are aware of the more colorful species which in the tropics grow perched on trees alongside orchids. These are the vriesens, guzmanias, aechmeas, and tillandsias. They are ideal plants to grow in the small greenhouse or solarium, for they are at all times attractive, do not grow out of bounds, and require no special care.

Bromeliads are almost all similar in form, being composed of a rosette of leaves, out of which emerges the inflores-

cence. Here the similarity stops, however, for each species has definite characteristics which set it apart from others—a fact which makes the collecting of bromeliads a fascinating hobby. There are bromeliads tiny enough to fit into dish gardens, while there are others so massive as to be out of place in the average greenhouse. Their rosettes may be tall or flat, loose or compact. Their leaves may be grasslike or strap-shaped, stiff or pliable, smooth-edged or armed with spines, plain green or bicolored or brightly marked with bizarre figurations. The flower stalk may rise high above its nest of leaves or snuggle deep within the heart. The inflorescence may take any one of a number of forms, depending on the genus, and though the actual flowers are usually small and short-lived, they are often followed by brilliantly hued berries which last in color for many months. The flower bracts, also, are vivid in their coloring, lasting in some species an entire year.

The colors to be found in the inflorescences are unique in the plant world, for they are blended with an utter disregard of all rules—reds, blacks, blues, pinks, purples, yellows, greens, combined to give

The pineapple (*Ananas comosus*) is one of the most familiar of the bromeliads.

Graf



dazzling effects. The blooming season of the different genera varies, and it is possible to have plants in flower the year round. However, bromeliads do not need to be in flower to be attractive, for as foliage plants they have no peer. For this reason they are good foils for such orchids as cattleyas, which, when out of bloom, are lacking in beauty.

Easily Cared For

Bromeliads are plants which can almost take care of themselves. As most of them are epiphytic, growing on trees instead of ground, their root systems are negligible, being used chiefly for anchorage. In their native habitat these plants obtain their water and nourishment from what falls into the cup formed by the encirclement of leaves. Under cultivation bromeliads also prefer to receive their sustenance in this manner. They need a well-drained porous planting mix, on the acid side, and a pot that is not too large. Fir bark, lapun (tree-fern fiber), osmunda, or any of the orchid mixes are suitable. The leaf cup should contain water at all times and the leaves need to be frequently sprayed. A light feeding with a soluble fertilizer about once a month the year round will be beneficial.

Although bromeliads will live in dark corners, most of them prefer good light. Direct sunlight, however, is not recommended.

The plants are exceptionally pest free, although occasionally scale insects may attack them. These can be eradicated by dipping the entire plant in a Malathion solution (such as is used for orchids) and allowing the plant to dry on its side. No Malathion should ever remain in the cup.

Bromeliads may be propagated either by seed or by offshoot. The bromeliad plant blooms only once, but when it reaches maturity will send forth offshoots. These may be detached from the mother plant when their base seems firm to the touch and the leaves are approximately four to five inches in length. The offshoots may be started in sand, moss, or regular potting mix.



Padillo

The larger bromeliad in this picture is the hybrid *Vriesea* called 'Mariae.' It has bright yellow and red flower spikes.

Which Kinds to Grow

The grower who desires to introduce bromeliads into his greenhouse has a wide selection from which to choose and there are species to suit every taste. Perhaps the most popular of all bromeliads is *Aechmea fasciata*. The silver-banded leaves form a natural Grecian urn, out of which arises a pale pink flower stalk studded with powder-blue flowers. *Aechmea fulgens discolor*, with gray and purple leaves and bright red berries, is another popular easy-to-grow species.

Two vrieseas which should be in every starter collection are *Vriesea* 'Mariae' and *V. splendens*. The first, known as the "painted feather," brings to mind the gaily colored plumage of a tropical bird with its flattened flower-head of gleaming carmine and chartreuse. *V. splendens*, known as the "flaming sword," is elegant



Padilla

The bracts of the bromeliad *Guzmania lingulata* var. *cardinalis* give the effect of a brilliant red flower. Individual flowers, one above each bract, are white.

merely as a foliage plant. The graceful recurved leaves, about a foot in length, are marked with broad cross-bands of purplish black. When it blooms, its flower-head emerges like a fiery sword high above the striking leaf-rosette.

Guzmanias, which are closely related to vrieses, are also adaptable to the average greenhouse. Most popular are *Guzmania lingulata*, with soft-green leaves and bright-red flattened flower-head, and *G. musaica*, with bizarrely marked leaves.

Neoregelias and nidulariums will do well in the dark corners of the greenhouse where few other plants will succeed. If the glass extends to the ground, there will be sufficient light to grow these bromeliads under the benches. Particularly interesting is *Neoregelia carolinae tricolor*, the leaves of which are strikingly variegated with ivory to greenish-white lines. When the plant is ready to bloom

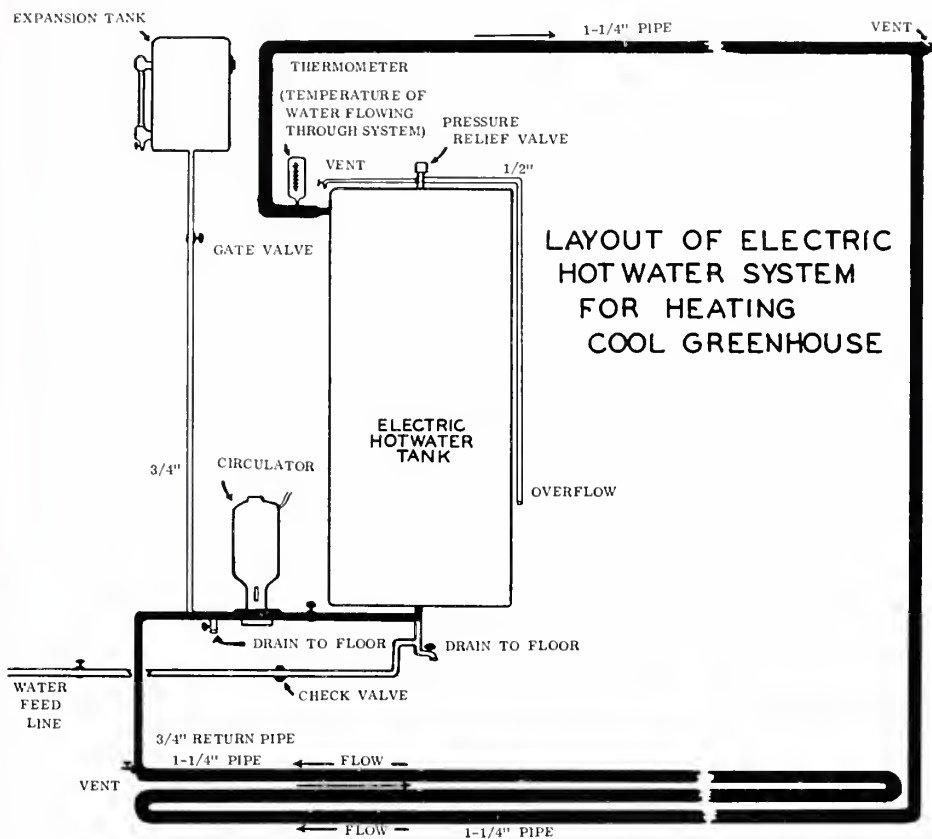
the whole heart turns a vivid red and remains so for many months. This bromeliad can be propagated only by suckers, as the seedlings do not develop variegated foliage.

Tillandsias should also be included in the greenhouse. The little gray xerophytic types will do well affixed to dead tree limbs to form a living bromeliad tree, or tucked into orchid baskets to grow with laelias or epidendrums. The popular *Tillandsia lindeni* and *T. cyanea* make handsome pot specimens, especially when allowed to multiply in the container.

Although bromeliads are still comparatively unknown in this country, they are gaining recognition, partly because of the work of The Bromeliad Society, which was organized a decade ago to promote interest in this family of plants.* The society puts out a bi-monthly publication, the only one devoted solely to bromeliads.

*Interested persons may write to The Secretary, The Bromeliad Society, 647 South Saltair Avenue, Los Angeles 49, California.

ELECTRIC HEATING FOR A COOL-TEMPERATURE HOUSE



Plan of low-cost heating system for a semi-pit greenhouse. A domestic water heater furnishes adequate warmth for all but tropical plants.

A PRACTICAL and not-very-expensive heating system for a small cold greenhouse was built and tested some years ago at the Brooklyn Botanic Garden. It has been in use in two greenhouses since 1954, and no difficulties have developed. It requires no heater with fire or fumes, no chimney, no boiler room, and no man power.

The heating system consists of a large size domestic electric water heater to which a simple coil radiator system and expansion tank are connected. When the

thermostat gives the signal, a small electric circulator pump sends hot water through the coils. Thus water and electric lines are the only services.

The greenhouses in which this system has been installed are semi-pit structures. In climates like New York City's, all but tropical plants can be grown successfully in them. Plants requiring a warm temperature at night can be grown if an insulated cover is put over the glass on cold winter nights.

The two semi-pit greenhouses are un-



Buhle

The semi-pit greenhouse, 35 by 11½ feet, at the Brooklyn Botanic Garden in which the electric water heating system was first installed. It has a dirt floor two feet below ground level, and a duckboard walk. Soil level at back wall (north) is 5 feet high.

attached to any other building. They face south, and walls supporting the glass are made of cement blocks with outside dimensions 35 by 11½ feet (see illustration above).

Interior of the semi-pit cool greenhouse. Bench at right provides 100 square feet of space for plants. At left, four partially overlapping shelves, 18 inches apart and each narrower than the one below it, give 200 additional square feet of growing space.

Buhle



Effect of Sun

Heat from the sun gives the greenhouses surprising warmth on clear, cold winter days, but at night and on cloudy days, temperatures fall rapidly. For example: on sunny days with an outdoor temperature of 22–35° F., the greenhouse reaches a sun-heat peak of 75° F. to over 80° at noon and remains at those temperatures for two or three hours. During the entire day, the temperature remains above 50° F. for six to eight hours or longer. During the hour that includes sunset, the greenhouse temperature may drop 15 to 20 degrees in a half-hour.

Thermostat at 50°

The thermostat is generally set at approximately 50° F., so that the hot water begins to circulate when the greenhouse temperature reaches that point. The two 4-kilowatt heating elements (total 8 kw.) cannot fully meet the demand on colder nights. When the outdoor temperature drops to 0° F. or lower, the greenhouse temperature will gradually fall to about 40° F. by early morning, but this still leaves a safety margin of 8 degrees above freezing.

Warmth on Coldest Nights

The 80 gallons of water at 170° that go into action after sunset on a cold winter evening, plus heat from the tank's electric units as they come into action, have proved sufficient to keep the greenhouse above freezing during the coldest nights experienced since 1954. The highest weekly consumption of electricity during cold winter weather has been 500 kilowatts. If an insulated cover had been spread over the expanse of glass each night, the electric consumption could have been considerably reduced. With reasonable care being exercised, the total electric consumption from late November through early March has been held to about 5,000 kilowatts.



GREENHOUSE STORY IN ENGLAND

With history dating from the Greeks and Romans

E. A. Smith

(Condensed from an address before the Circle of Glass Collectors at the Glass Manufacturers' Federation in London, February 21, 1963, and used by permission of the Circle and the speaker.)

THE greenhouse story, in England, is one of slow progress which follows the social pattern so closely that one can speak with reasonable accuracy of the Orangerie age, the Restoration; the Stove era, the Age of Elegance; and of the Greenhouse and Conservatory period, the Victorian era. It was to be expected that it would be in a northern climate, where there was a wealthy aristocracy, with the necessary leisure and inclination, that a great greenhouse culture would flourish.

Greek and Roman Practices

The Greeks knew of the advantages of "glass" and heat, as did the Romans.

Branches of flowering trees, grain or bulbs were put into pots or earthenware dishes and a form of bell-jar placed over them and placed on flat roofs in the sun to help them to mature in time for the great fertility feast of Adonis. Pliny tells that Tiberius Caesar ordered his gardener to produce cucumbers every day. They were successfully grown daily in pits with fermenting dung covered with frames of mica or gypsum (tale).

Sir Joseph Banks, 1743-1820, President of the Royal Society, who remarked on dessert fruit forcing in Roman times in the Horticultural Society Transactions, claimed that the forcing was done by means of stoves and that the "glass" was Muscovy glass (*lapis specularis*) actually sheets of mica split thinly. This method of glazing windows was widely used in Rome.

A building which archaeologists have called a *specularia*, was found at Pompeii. It has platforms for displaying plants, hot air flues in the walls and evidence of having had tale or rough glass in front.

Beginnings in Western Europe

The first recognisable attempt at early greenhouse practice in Western Europe was made by Albertus Magnus, a Paduan, who in 1259 is said to have entertained William of Holland, King of the Romans, in a garden maintained in flower and fruit by artificial heat. Another reference to these early attempts is in a letter signed "John" dated 1358 stating that "in the Bois de Duc in France they grow flowers in glass pavilions turned to the South." In 1619, at Heidelberg, Salomon de Gans used the first movable wooden structure said to have been fitted with glass, to shelter 400 orange trees belonging to the Elector Palatine. Between 1680 and 1687, the first plant houses were built in Holland at Leyden Botanical Gardens and according to Herman's catalogue of 1687 the gardens had heating equipment although the evidence suggests the buildings had opaque roofs with glass framed fronts.

Probably the first reference to hothouses as distinct from Orangeries or winter-plant shelters is in "Four Books of Husbandrie" by Barnaby Googe published in 1578. In "A History of English Gardening" by G. W. Johnson, published in 1829, however, it is considered that these hothouses were rough wooden sheds warmed by a crude stove or hearth.

Sir Hugh Plat wrote of forcing and conservatory practice in "The Garden of Eden" published in 1675. Of a glass manufacturer, he writes: "I have known Mr. Jacob of the Glassehouse to have carnations all winter by benefit of a room that was near his glassehouse fire."

In 1654, Robert Sharrock, the Winchester Cleric and botanist, in his "History of the Propagation and Improve-

ment of Vegetables," printed at Oxford in 1660, describes hotbeds of dung covered with glass casements and shows that he knew that light and air were just as important as heat.

John Evelyn, 1620-1706, in his "*Kalendarium Hortense*" published in 1664 gives details of what to put in a house for "hybernising" and recommends that on all good sunny days without the "least stirring" the correct treatment for plants was "to shew them all the light through glass windows." John Evelyn also deserves mention as he is said to have been the first English writer to use the words greenhouse and conservatory.

18th Century Expansion

In the 18th century there is ample evidence of artificially heated hothouses and greenhouses in all parts of the country. A revealing glimpse of the 18th century botanists, scientists and plant lovers and gentlemen (all drawn together by the love of plants and flowers and experiment) is found in the letters of Richard Richardson, 1663-1741, of Brierley, Bradford, Yorkshire. He was a medical man apparently with plenty of time to give to his hobby of plant rearing, and writing to most of the other prominent plant lovers and botanists of his day, both in this country and abroad. The Doctor and John Blakburn, 1690-1786, of Oxford near Warrington, are said to have erected the first hothouse in the north of England.

Two brothers, William Sherard 1659-1728 and John Sherard 1666-1738, who were both eminent botanists, knew a great deal about stove and greenhouse practice, as their correspondence with Dr. Richardson shows. They visited Leyden where they inspected the stove built in the famous botanic gardens by the celebrated physician and botanist, Dr. Boerhaave.

Philip Miller, in his Dictionary first published in 1731, gives much sound advice on greenhouses and conservatories. In a later edition of his dictionary he amended his plans of greenhouses to show a glass roof. The first greenhouse

at Chelsea was erected in 1680 at a cost of £138 and a further greenhouse and two hothouses were built for Miller in 1732.

George Tod in his "Plans Elevations and Sections of Hothouses, Greenhouses, an Aquarium and Conservatories" printed at York in 1807 writes of houses he had designed in all parts of England. He had learned the lesson of glass roofs for all his houses. There was a hothouse for His Majesty at Frogmore, one for the Duke of Bedford at Woburn, and another for a Mr. John Anthony Buelier of Wandsworth Hill, Surrey, consisting of a peach house, a vinery, a pinery and standard cherry house, 240 feet long and 10 feet wide with seven stokeholes. Can one imagine the expense of such a house today?

At the Oxford Botanical Gardens a progressive outlook had prevailed from the days of their first solidly built conservatory of 1632. About 1726 the first conservatory, which had been turned into a herbarium, was replaced with a gift of £500 from Dr. William Sherard. Between 1734 and 1736 two conservatories were built. They are illustrated in the Oxford Almanack of 1766 and had long narrow windows, arched at the top, a high steeply raking front, with a small opaque roof more in the nature of a coping. The ends were solid but the glazed front was almost all glass.

It was not until the first half of the 18th century that regular structures roofed with glass were seen in England.

19th Century Developments

From 1800-1860 there were arguments on every aspect of covered garden buildings and one of the first items to come under closest scrutiny was glass. The methods and cost of manufacture, its quality and quantity greatly influenced the efficiency and the spread of the greenhouse. Until 1845, when the tax on glass was repealed, the price of glass remained at a high level so the cost was a big factor in the cultivation of exotic plants in winter shelters. Prior to 1845 a crate of

good crown glass was £12, in 1856 it could be bought for £2.8.0.

Glass and its Manufacture

The method of making glass played its part in the evolution of the greenhouse. For many years the greenhouse builder had no choice of glass but crown and broad, neither ideal for horticultural purposes as both types were marred in the process of making. Broad glass was obtained by cutting a glass cylinder as it cooled and ironing it out flat. This method produced a piece of glass seldom more than four feet square before trimming and cutting. Its surface was uneven and might be ridged, crusted or crumpled, and the inequality in thickness could vary considerably. Inequality of texture produced air bubbles, knots, streaks and varying shades of colour. Crown glass, which was spun into a circle on the end of a glassblower's pipe, was brighter than broad glass and considered better for greenhouses but could not be obtained in large panes. Both types of glass manufactured by these methods had to be used in many-paned window sashes with a consequent loss of light.

Angles and Tints of Glass

In the years 1844-8, when the Palm House was being built at Kew (designed by Decimus Burton and built by Richard Turner), the question of glass was the concern of many. There were problems of weight, angles of roofs and colour of glass to study. The colour of glass was the subject of great scientific discussion. Sun scorch had been noted by Dr. Lindley and during the building of the Palm House Robert Hunt read a paper to the British Association for the Advancement of Science on the type of glass most suitable for it . . . glass coloured a pale yellowish green by means of oxide of copper. This glass was used, but was taken out later as the idea was more correct in theory than practice. And when colourless glass was used the effect was soon shown in the improved vigour of the plants.

The angle of glass inclination to the

sun was another source of dispute. Thomas Andrew Knight, 1759-1838, President of the Horticultural Society, later the Royal Horticultural Society, said the angle should be 34° for ripening vines in July and 28° for the ripening of peaches about mid-summer. The Rev. Mr. T. Wilkinson, who wrote "Observations on the Form of Hot Houses," said 45°. At Leyden in the 18th century, Dr. Boerhaave, the Curator, required that the surface of his glass should be perpendicular to the sun's rays at the shortest day when most heat and light were required. His studies led to an adoption of an angle of 45° for the roofs of glasshouses by Miller of Chelsea, Dr. Richardson of Bradford and the Sherards of Oxford. With a comical disregard for scientific theorising as the scientists argued about theories of reflection and the difference of the sun's position at the Spring and Autumn equinox, gardeners built their houses with roofs at an angle of 45° as experience had shown them this was the most convenient slant to shed rain.

In Elizabethan times and for almost a century after, buildings in gardens were intended and used for amusement and were an extension to the house. Inigo Jones, 1573-1652, is reputed to have been the first architect to design a building for a garden with a banqueting room at Beckett in Berkshire.

The greenhouse was in practice an orangery, and the terms were synonymous. Excellent examples are still to be seen.

It is interesting to note that after the magnificent displays of the Victorian period, which disappeared as a result of the two world wars, people are today being encouraged to take an interest in exotic plants and to add a garden room to the house. It is estimated that there are 1½ to 2 million small greenhouses in England, not counting the commercial growers, covering some 436,000 acres.

Conservatory at Chatsworth

Sir J. Paxton, 1803-1865, built the huge conservatory at Chatsworth for the Duke

(Continued on page 95)

SOILS FOR HOME GREENHOUSES

James W. Boodley

A BRIEF look at some basic facts about the physical properties of soil will better enable the home gardener to understand the part that soil plays in plant growth.

Functions and Contents

Soil serves as a mechanical anchorage and support for plants and as a storehouse of minerals and water for nutrition and growth. It contains a conglomerate of living organisms and dead organic materials that are in a constant state of flux. Realization that the soil environment is not stable, that it changes continuously, is of great importance to the gardener.

Topsoil has three phases; that is, it is made up of three distinct kinds of matter: *solid* (50%), composed of both inorganic and organic materials; *liquid* (25%), composed of water with soil minerals in solution; and *gaseous* (25%), which is atmosphere, or air, in the soil. Overlooking the need for air is one of the frequent causes of plant failure.

Soil Particles

Texture of the soil is determined by the size of the solid particles that it contains. There are variations in each grade: *gravel* is coarse, *sand* ranks next, *silt* is fine, and *clay* is exceedingly fine.

Most soils are mixtures of various size particles. If a soil contains considerable quantities of at least two sizes, it is known as loam. It may be gravelly, sandy, silt or clay loam, according to the particle that predominates.

It is well to remember that the original components of a soil cannot be changed. By adding sand or peat moss, the ratio of materials may be altered, but it is impossible to convert a sand particle into a clay particle.

Structure of Soil

Sandy soils have a loose, open type structure that permits free movement of

water and air. But because they are porous, sandy soils have a low water-holding capacity. Plant nutrients are easily leached away. Since they are commonly low in fertility at the start, they require fairly large quantities of additional fertilizers.

Medium-textured soils are most desirable for plant growth, since they can be worked without harm over a fairly wide range of moisture levels. They hold moisture and nutrients better than sandy soils, and furnish more air for the roots than clay soils can provide.

Fine-textured soils such as clay loam are undesirable. When wet they cannot be tilled without injuring soil structure. During the winter when drying conditions are poor, they are easily overwatered. The excess water drives out the air and results in oxygen starvation of the plants; this in turn reduces the rate of growth.

Measuring Soil Structure

A simple measure of relative soil structure is the ease with which the ground may be penetrated with a half-inch dowel. If the rod is difficult to insert, the soil is too compacted for good plant growth. If this is the soil to be used for a greenhouse potting mix, it should be modified to a more open type structure by the addition of sand, peat moss, or Perlite—or all three. The peat moss provides organic matter which improves the physical condition of the whole mass. Coarse sand and Perlite improve drainage and air entry by loosening heavy soils.

When organic matter is added to sandy soils it binds the particles together, giving coherence to the soil. It also markedly increases the capacity of sandy soils to hold water and nutrients.

Increased microbiological activity also results from the addition of organic mat-

ter to soils. The end-result of this is to make more nutrients available to plants.

Mixing Greenhouse Soils

Satisfactory soil mixtures for greenhouse planting will vary with the parent material used. Basically, 2 parts (by volume) of virgin field soil, 1 part sphagnum peat moss and 1 part coarse concrete sand or horticultural Perlite will

provide a satisfactory medium for practically all greenhouse crops whether bench grown or pot grown. If the parent soil is a heavy, clay type, a 1-1-1 mixture of the above is satisfactory. With sandy soils, 3 parts by volume may be used with 1 part each of peat moss and sand or Perlite. Experimentation with various mixtures will soon tell the gardener which one is best for his particular purposes.

To Pasteurize Soil

SINCE all field soils contain disease organisms, insects and weed seeds, it should be pasteurized before being added to a greenhouse mix. A simple method is to use $2\frac{1}{2}$ tablespoons of commercial formalin (formaldehyde) to 1 cup of water for each bushel of soil treated. Spread the soil in a 2-inch layer on a clean surface; sprinkle the formaldehyde as uniformly as possible over the top of the soil; mix thoroughly; replace the treated soil in clean boxes (these may be stacked), then cover the stack with plastic film or wet newspapers. After 24 hours remove the covering and let the soil air. When all odor of formaldehyde has gone, the soil may be used for planting.

Small quantities of soil may be heat-treated by cooking in a 250-degree oven for 15 minutes. For most efficient treatment, the soil should have a moisture content equal to that when in a good, friable planting condition.—J.W.B.

AN ELECTRIC SOIL PASTEURIZER

Especially effective for treating such common greenhouse soil ailments as nematodes and damping-off fungi—and for destruction of weed seeds, this electric soil pasteurizer (shown with top open) is practical in the home greenhouse. Unless soil is completely changed annually, pasteurization is essential. The unit shown here is available from Dillon Industries, 22 Eastern Avenue, Malden, Massachusetts. A portable electric soil sterilizer is obtainable from American Sterilo Company, 60 West 41st Avenue, San Mateo, California.



FERTILIZATION PROGRAMS FOR HOME GREENHOUSES

John W. Mastalerz

OF the many elements essential for plant growth, twelve are absorbed by plant roots from the soil. Nitrogen, phosphorus, potassium, calcium, magnesium and sulfur are required in large quantities and are referred to as the major elements. The elements needed in small quantities—iron, manganese, boron, zinc, copper and molybdenum—are called trace elements.

Recommended fertilization programs are based on the major elements. In most soil mixtures, trace elements normally are present in sufficient quantity for good plant growth; or they are supplied as impurities when plants are fertilized with compounds containing the major elements. Because they are required in extremely minute quantities, trace elements should not be added to soil mixtures as insurance unless it is positively known, through a soil test, that the supply of one or more is deficient. When this occurs, only the element in question should be added.

Standardization of Soil and Fertilizer

The fertilization of container-grown greenhouse flowering plants can be greatly simplified by using a recommended soil mixture and standardizing the quantity and frequency of fertilizer application. The soil mixtures recommended for home greenhouse use should have the following features to permit a standardized fertilization program.

- (1) Excellent drainage so that excess fertilizers can be readily leached from the soil mixture if they accumulate; yet water and fertilizer retention must be adequate to meet plant requirements.
- (2) Freedom from soil-borne disease organisms, insects and other soil pests. Soil pasteurization will eliminate these troubles and thereby make fertilizer applications more effective.

- (3) Low fertility to avoid root injury from excess salts and to promote rapid seed germination and establishment of transplanted seedlings and rooted cuttings. It is easier to add fertilizer elements when needed than it is to remove those in excess.
- (4) Uniformity in composition from one quantity of a soil mixture to another to permit standardized fertilization programs. Without this uniformity, the rate and frequency of fertilization must be adjusted for each new quantity of a soil mixture.

To fertilize the kinds of plants that are usually grown in the home greenhouse, several standardized programs can be suggested. Inorganic or organic fertilizers, low in analysis, of the type used on lawns (example: 5-10-10 or 10-10-10) can be applied on the basis of soil test results. However, they are difficult to distribute uniformly, the nutrients they contain may or may not be quickly available to the plants, and to maintain an even level of soil fertility is difficult.

It is more desirable to apply fertilizers in solution. Many excellent formulations of soluble compounds are available. They can be applied quickly and uniformly; the nutrients move with the water into the soil and become immediately available to plant roots; and control of the degree of fertility is relatively simple.

Amounts to Apply

Experience has shown that, except for acid-soil plants, greenhouse soil mixtures require 8 ounces of lime for each 10 square feet of bench area or 2 ounces per bushel of soil mixture. Superphosphate, which supplies both phosphorus and sulfur, is applied at the rate of 12 to 16 ounces for 10 square feet or 3 to 4 ounces per bushel of the soil mixture.

It is best to incorporate ground limestone and superphosphate at the time the

soil mixture is prepared. In many areas, dolomitic limestone (which contains magnesium in addition to calcium) may be more desirable.

To meet plant needs for nitrogen and potassium, fertilizer solutions may be applied according to a schedule, or a dilute solution may be used each time the plants are watered.

When a regular schedule is used, a fertilizer solution containing 3 to 4 ounces of 25-0-25 or 20-20-20 (depending on the need for phosphorus) in each 10 gallons of water* is applied once each week from April through September and once every two weeks from October through March. This seasonal change in frequency adjusts the amount in relation to the sunlight available for plant growth. It is equally practical in winter to use one half of the recommended rate and fertilize once each week from October through March.

When a dilute solution is used each time the plants are watered, the quantity of fertilizer applied is automatically adjusted to the rate of plant growth. This new technique has proved highly effective. As light intensity increases, temperatures are usually higher, plants grow faster, and their need for water increases. Also when plants grow faster, more fertilizers are required. With this method, a low but constant level of fertilizer is available to the plants at all times; and the high and low fertility levels (flood or famine situation) that may occur in scheduled fertilization are avoided.

For application with each watering, the rate is $\frac{1}{2}$ to $\frac{3}{4}$ ounce of 25-0-25 or 20-20-20 for each 10 gallons of water. Pots should have $\frac{1}{2}$ to $\frac{3}{4}$ of an inch of space and are filled to the brim with the fertilizer solution. For bench areas, approximately 2 quarts of the solution are applied per square foot.

*The quantities of fertilizer suggested above are designed for greenhouse crops; they would be excessive for house plants under reduced light intensities.

Soil Testing

(For complete list of soil-testing laboratories in all states and in six Canadian provinces, together with addresses, see the **Handbook on Soils** of the Brooklyn Botanic Garden.)

NO proper fertilization program can be recommended without an accurate knowledge of the soil's content and its needs. Greenhouse soils can be most satisfactorily tested by the State Agricultural Experiment Station. If you do not know where it is, inquire of your County Agricultural Extension Service at the county seat.

When soil test kits are used with care by the grower himself, the results can be very useful. But to assure accuracy, the chemical reagents should be renewed regularly. This may not be done for the home greenhouse kit because of the small number of soil samples used.

To take samples so that they are representative of the entire soil mixture, scrape away the top $\frac{1}{4}$ to $\frac{1}{2}$ inch of soil, and with a trowel or soil sampling tube take a core of soil from top to bottom of the bench or pot. Several cores taken at random are essential to reduce the variations in nutrient content found in any one location.

The report from an accurate test, in which results are determined by instruments rather than the color comparisons of home test kits, will tell the grower precisely the amounts of major elements to use.

Soil tests should include a soluble salts test, which measures the total salt content of the soil. Poor growth resulting from high salts is one of the more common problems observed in the production of greenhouse flowering plants. High salts can be reduced by leaching the soil several times with water to flush them from the root area.—J.W.M.

PLANT PROPAGATION IN A GREENHOUSE

James Underwood Crockett



Freese

Sowing seeds in a greenhouse is an easy way of obtaining early plants for the outdoor garden as well as fresh stock for the greenhouse itself.

A COMMON discovery among owners of home greenhouses is that the structure is soon full to overflowing. The desire to have a larger greenhouse may be held in check by the inner realization that no matter how large a one is acquired, it will never meet a person's needs. Thus he must learn to tailor his dreams even though this means leaving out some desirable plants and discarding those that threaten to take over the whole area.

In the propagation of plants, he must also learn moderation, or soon his green-

house will become so crowded that none of the plants will grow properly. Yet the greenhouse is ideal for starting plants into growth.

A single flat of snapdragon seedlings may contain 500 plants, yet a home gardener might need no more than 25 plants. It is clear that he must sow only a few seeds; a single row across a flat will give more plants than he can use. Perhaps he would like to start a dozen tomato plants for his garden; a package of seeds will produce 75 to 100 plants. Restraint is urgent.

These words of caution should not discourage greenhouse hobbyists from growing new plants; they are simply words of experience meant to save over-ambitious flower lovers from injuring all their plants by trying to grow more than space will allow. The following methods of plant propagation are all relatively easy and will be found to be immensely rewarding.

Plants from Seeds

It takes but little skill to grow plants from seeds, especially in a greenhouse where the seedbed can be protected from the elements.

A standard seedbed soil mixture is composed of one part each of sharp sand, loam, and peat moss or leaf mold. This mixture may be used in pots or flats, depending upon the quantities of seedlings desired or the space available. Generally speaking, seedlings seem to do better if sown thinly in widely separated drills in a flat than when crowded together in a pot. Greater air circulation and additional light received by the plants in the flats may account for their thriffter growth.

Use a coarse mixture for the lower level of the seedbed, to facilitate drainage; sift the soil for the top layer, in order that moisture may be held about the seeds themselves. Firm the seedbed, making sure that it is level and about one-half inch from the top of the container. Sow the seeds in drills and barely cover them with sifted soil; never cover them more than twice the diameter of the seeds.

Water the seedbed thoroughly after sowing. Often this one watering will suffice until after the seeds sprout. Unless the soil has been sterilized, the first watering should contain a disinfectant to inhibit the growth of damping-off fungi. Otherwise the young seedlings may be killed before they develop their first leaves. Seed stores and seed catalogs carry various such preparations. Some can be used with only certain kinds of plants, so read the instructions carefully.

A final step after seed sowing is to provide for high humidity in the air above the seedbed. This may be done by placing a pane of glass over the flat or by enclosing it in a plastic bag. Set the flats or pots where they will get filtered light until seeds sprout. The covering can then be removed and the seedlings given full light.

When large enough to handle, the seedlings should be transplanted into small separate pots of clay, plastic or peat fiber. This enables each plant to grow without competition from its neighbors. Plants in peat pots have the added advantage that they may be planted, pot and all, into the garden or greenhouse bench.

New Plants from Cuttings

Not all cultivated plants will reproduce themselves exactly when grown from seeds because of the heterogeneous nature of the ancestry of many of them. For that reason, as well as because of speed and convenience, gardeners grow many plants from vegetative cuttings. Stem, leaf, leaf-bud and root are the principal parts used. The new plant will be exactly like the one from which the cutting was taken.

In simple terms, cuttings should be either snapped off or taken with a sharp clean knife. They are then inserted in sand, vermiculite, peat moss, Perlite or even water until roots are formed. At this stage they are potted into soil and given the care required of the species. Cuttings that are difficult to root benefit from dipping in a root-inducing hormone powder.

A home greenhouse may well have a small area of a bench set aside for cuttings. The rooting medium here must be changed occasionally because it will become contaminated with bits of decaying stems, the bacteria from which will attack stems of new cuttings. As an added precaution against disease, the medium may be drenched with a disinfectant, and cuttings may also be dipped in such a solution. Your seed store or nursery will recommend a formula or brand.



Taylor

Tightly wrapped polyethylene film surrounds the moist sphagnum through which new roots work their way in air layering.

Air Layering

Air layering consists of rooting the upper part of a plant while it is still attached to the parent plant. This method is used on plants that are otherwise difficult to propagate, and also on plants that have grown tall and lanky.

An upward cut is notched in the stem of the parent plant about two-thirds through the stem. A pebble or matchstick may be inserted in the cut to hold

it open. If desired, the open cut may be dusted with a root-inducing hormone powder. Then it is wrapped in a ball of moist sphagnum moss, which in turn is covered with clear plastic to hold in the moisture. In a short time roots will be seen through the plastic. When they are well developed, cut off the stem where the notch was made, remove the plastic, but not the moss, and pot the newly rooted plant in soil.

How to Use a Grafting Case

The amateur gardener who wants to try to propagate more difficult plants may have occasion to use a grafting case. Its purpose is to maintain a very high degree of humidity so that plants which do not root from cuttings may be induced to grow onto the stem of a related plant by grafting. The case itself is usually built on a bench and amounts to a little greenhouse within the larger greenhouse.

The blue spruce is usually propagated in a grafting case. A seedling Colorado spruce is used as the understock. It must be well established in a pot before the grafting commences. A blue spruce scion (a tip cutting) is inserted in a cut made in the side of the stem of the Colorado spruce, wrapped to hold it in place, then laid on an angle within the case so that moisture will not lie on the graft itself. When the graft union is completed (in perhaps two months), the top of the Colorado spruce (the understock) is removed, leaving the blue spruce to grow from the roots provided by the Colorado spruce.



USE OF COLDFRAMES IN PROPAGATION

When plants are being multiplied, they complement the greenhouse and help to solve the problem of space

NEW owners of greenhouses soon discover that most of their plant propagation activities are directed toward producing quantities of young plants during winter and spring months to be used in their outdoor gardens during the

summertime. In the greenhouse proper there is a limited need each year for plants to be grown from seeds or cuttings for winter bloom. In addition there is a modest need from time to time to propagate young plants of desirable types to



Shedsky, courtesy of Flower Grower

A coldframe is an indispensable aid for greenhouse as well as outdoor gardening.

replace older plants which have become too large. Greenhouse owners, private and commercial, share the common problem of space limitations. In spring when greenhouse walls are fairly bursting with growing plants, some way must be found for temporary expansion.

Although commercial greenhouse operators have long resorted to coldframes and hotbeds to alleviate the extra burden of spring growth, relatively few home gardeners have learned to take advantage of the inexpensive growing area they afford. In its simplest form a coldframe is a glass- or plastic-covered box within which plants may be protected from the chilly days and nights of springtime. During colder nights a mat may be thrown over the glass to help conserve some of the heat built up during the daytime hours. (Coldframes may also be used to give winter protection to certain plants of borderline hardiness, but here we are considering them from the plant propagation standpoint.)

A hotbed is merely a coldframe with heat. Nowadays the easiest way to convert a coldframe into a hotbed is to install an electric soil-heating cable.

Permanent coldframes are often constructed of concrete, but home gardeners will be interested in some of the portable aluminum models now on the market. These can be set up quickly in the spring and taken down easily for storage during the balance of the year. Coldframe sash should be 12 inches above the soil at the lower side. An upward slope from there will help in gathering warmth from the sun as well as in draining off condensation and rainfall.

Plants in coldframes are best grown in pots so that they can be transferred to the garden without shock when the weather becomes warm enough for outdoor culture. Although many small plants are being grown in plastic and clay pots, the "root through" pots of peat moss or bagasse (sugar-cane fiber) are being increasingly used. Plants growing in these pots are planted, pot and all, into the garden with a minimum of trouble and no setback in growth.

Since coldframes are used mainly during the winter and spring, it is often helpful to bank soil up around the sides to aid in conservation of heat. It is likewise a good idea to locate coldframes in



Buhle

Double plastic covers with air space between give extra protection to plants in coldframe.

protected spots out of the sweep of spring winds. They should always be set where there is good soil drainage.

The operation of coldframes consists chiefly of closing the covers at night and opening them each morning. The extent to which covers are opened will depend upon outdoor temperatures. On chilly

days they should be propped open only enough to keep inside temperatures from rising too high. With the advance of spring the covers should be removed entirely during the daytime hours. This will enable the plants to acclimate themselves to outdoor growing conditions; the process is known as "hardening off."

This aluminum coldframe can be dismantled and stored when not in use.

Courtesy of Lord & Burnham



HOW TO CONTROL DISEASES AND PESTS IN A GREENHOUSE

H. Thurston Handley, Jr.

GOOD sanitation practices constitute the first line of defense against plant damage by insects and diseases. Since it is better and easier to prevent trouble than to cope with it, let us consider first what good sanitation implies.

First of all it means keeping the greenhouse and potting area clean. Remove all plant debris promptly and keep the walks and the areas under the benches clear of rubbish and weeds. (Floors are best covered with coarse gravel, and walks paved.) Screen all doors and ventilators during the summer to keep flying insects out, and seal cracks around the foundation and doors against the intrusion of crawlers. In outdoor areas near the greenhouse eliminate weeds and rubbish, because they are possible sources of insect infestation.

In summer, when the greenhouse can be emptied of plants, take time to wash all benches and walks thoroughly. Also wash the inside glass, then spray the whole place with a complete insecticide-fungicide solution.

Recognition of Plant Diseases

Diseases of plants are most frequently caused by plants of a different nature, generally microscopic in size, and therefore seldom seen. These minute organisms live and grow on the plants they infect, deriving their nourishment from them. The first indication of their presence is usually the injury they have caused.

How, then, shall you recognize a plant disease in your greenhouse? Numerous symptoms indicate infection and, though they do not always point to a specific disease, they do tell you that control work is needed. Among these symptoms are leaf spotting, wilting of branches or

the whole plant; rotting of roots, flowers, stems or leaves; stunted growth, powdery incrustations of foliage, and white or yellow streaks on the leaves. Many of these symptoms could also apply to cultural disorders such as poor fertility or lack of water.

Although it is difficult for the amateur to identify plant diseases, or even determine if the trouble is an infectious disease, he can forestall damage by sanitation procedure, and minimize it by the use of fungicides.

Precautions Against Disease

Plants that are obviously diseased should be destroyed or moved away from healthy plants until they recover. Other precautions are: Be sure that all new plants introduced to the greenhouse are free of visible signs of disease. Do not use soil or containers in which plants have died. Use clean tools, reserved exclusively for the greenhouse. Be sure your hands and cutting tools are washed thoroughly before you work in the greenhouse after being outdoors.

Most plant diseases thrive best under conditions of high humidity and poor air circulation. In watering your plants, avoid wetting the foliage. Ventilate and heat the greenhouse so as to avoid stagnant air conditions and condensation of moisture. Never crowd your plants.

Thoughtless behavior spreads diseases. Do not allow yourself or friends to set feet on greenhouse benches. Always hang the hose nozzle on a hook to avoid picking up disease organisms from the floor.

For greenhouse soil use a virgin field type in which flowers have not been grown for several years. If this cannot be obtained, sterilize the soil you use. Wash pots thoroughly in hot soapy water

before re-using them. If clay pots have contained diseased plants, boil them for 15 minutes to destroy bacteria. Plastic pots can be disinfected by soaking them in a solution of 1 part household chlorine bleach to 20 parts of water.

Sprays to Use

Fungicides are chemicals which kill or prohibit the spread of disease organisms. They are best used in combination with insecticides for a complete pesticide spray. Generally only one is included in a mixture containing several insecticides and a miticide for general pest control. Common fungicides include Zineb, Ferbam, Karathane, Captan and sulfur. All of these will kill many, but not all, disease organisms. Follow exactly the manufacturer's direction when using them.

Insect Pests

Insects are the number one problem in many home greenhouses. Fortunately, all of them can be controlled. Before tackling the problem, however, consider these four points: the type or variety of insect, the plants infested, weather conditions and proper control procedures.

Many greenhouse pests attack only certain plants. Therefore it is a good idea to know which ones are likely to appear on the various plants you raise. Examine your plants carefully from time to time. By recognizing a trouble-maker at an early stage, you can prevent large infestations by killing the pests before they multiply. Inspect new plants for insects and clean off any that are present before bringing the plants into the greenhouse. Also examine plants that were kept outdoors during the summer or exhibited at a flower show.

Conditions Affecting Insects

Outdoor weather and greenhouse environment influence insect activity and have a bearing also on control measures. Under greenhouse conditions, many insects which would perish outdoors or become inactive during the winter can be destructive all year. A constant tempera-

ture of 70° F. usually provides better conditions for insect multiplication than a 50° temperature. Warm days similarly favor insect growth more than cloudy, cool days. Weather also limits to some extent the use of pesticides, since it is better not to apply them on hot sunny days when they might burn foliage or during cool dark weather when drying conditions are poor.

Eliminating Minor Attacks

If only a few insects are present, or just a few plants infested, washing the foliage and stems with lukewarm soapy water (two teaspoons of mild soap flakes to a gallon) will often control them. The plants can either be sprayed and rinsed or washed with a soft cloth. If the insects are large, they can be picked off with fingers or tweezers. If small, they can be daubed with a cotton swab dipped in rubbing alcohol. Individual plants of no particular value which are badly infested are best removed and burned as a precautionary measure.

How to Use Insecticides

The best time to apply insecticides is before the infestation is well established. The commercial practice of a routine monthly application is a good idea. Insecticides are applied as sprays and dips. For spray applications use a compressed air sprayer or a hand atomizer which breaks the mixture into fine droplets. For dipping plants use a large galvanized pail and rubber gloves. The same pesticides are used for both methods. A mixture of several kinds is best because none will deal with all types of pest. Blends formulated for outdoor use and available at garden supply centers are often suitable for greenhouse use, or you can mix your own. Add a few drops of liquid detergent to each gallon of spray to make it adhere better and penetrate crevices where insects hide.

Chemicals commonly used in home greenhouses include DDT, Malathion, Methoxychlor, Kelthane, Lindane, Tedion, and Thiodan. Each is rather specific for

a given group of insect pests so the following combinations are recommended for all-purpose sprays:

Group 1. DDT, Malathion, Lindane, Tediion.

Group 2. Methoxychlor, Lindane, Malathion.

Group 3. DDT, Lindane, Kelthane.

Group 4. DDT, Thiodan, Malathion.

When preparing insecticides consider the following points:

1. DDT and Methoxychlor are interchangeable, give good residual results and kill many insects on contact.

2. To kill spider mites, include Kelthane, Malathion, or Tediion.

3. To kill sucking insects and others not affected by DDT, include Lindane, Malathion, or Thiodan.

4. Include fungicides if needed to provide disease control.

5. When mixing insecticides, use formulations of the same type: wettable powders with wettable powders, emulsions with emulsions, etc.

6. FOLLOW ALL DIRECTIONS AND OBSERVE ALL PRECAUTIONS GIVEN BY MANUFACTURERS

ON THE LABELS WHEN MIXING AND APPLYING INSECTICIDES. USE PROTECTIVE GLOVES AND RESPIRATORS IF RECOMMENDED.

7. Never exceed the manufacturer's recommended rates when mixing pesticides, and apply them only to the plants designated.

8. When applying pesticides be thorough—but careful.

9. Do not use pesticide mixtures designated for the control of household insects; they are seldom suitable for plants.

Chlordane and pyrethrum can be used alone for specific insect problems. Chlordane is effective as a soil insecticide to kill ants, grubs, grasshoppers, roaches, and other crawling pests. Pyrethrum sprays, or aerosols, will destroy flying insects but should not be used on the plants themselves unless specifically recommended.

If an insect appears which cannot be identified, or a disease occurs which defies control measures, send a sample of the insect or the diseased portion of the plant, to your State Agricultural Extension Service or County Demonstration Agent for identification and recommendation of control measures.



(Continued from page 83)

of Devonshire between 1832-36. It was a wonder of the day.* It took several years to build, and cost £11,867.

Inside the house, at a height of 25 feet from the ground, there was a balcony round the centre part of the house reached by a spiral staircase built inside a mass of ornamental rockwork. Nothing utilitarian was allowed to appear in the conservatory, heating was supplied by boilers underneath the house and coal ashes were supplied and removed by an underground railway. The smoke flue from the submerged boilers travelled several hundreds of yards to a chimney hidden in the woods behind the house. The Duke was very pleased with his building and when Queen Victoria and

Prince Albert visited Chatsworth, they drove through the house in a carriage.

Another work by Paxton at Chatsworth was the special house designed for the giant Amazon water lily, the Victoria regia, discovered in 1833, and housed at Chatsworth in 1850.

Although this enthusiasm for building glass houses and collecting rare plants was an excuse for ostentatious displays of wealth, British gardeners grew almost everything which could be grown.

Frederick Boyle, a writer on orchids, states that it was not until Victorian times that civilised man could cultivate and enjoy that flower. In order for him to do so, it had been necessary to develop commerce, build ships and communica-

(Concluded on page 97)

*The founder and endower of the Missouri Botanical Garden, in St. Louis, U.S.A., Mr. Henry Shaw, was inspired to build his first greenhouse after seeing Paxton's great conservatory at Chatsworth.



Roche

Sand in cutting bench is kept uniformly moist by automatic ball-float control system.

(Continued from page 65)

breaks the night into two more or less equal parts. Recent research indicates that during periods of darkness a hormone is produced which changes vegetative growth to bloom production in short-day plants. Light inhibits production of this hormone.

Shading is accomplished by enclosing a given bench area with Black Knight cloth* (or its equivalent). The cloth is attached to a frame which permits it to be pulled over and around the bench all the way to the bottom. This is generally done about 6 p.m., and the cloth removed about 7 a.m., but as long as a continuous 13-hour period of darkness is provided, the schedule can be varied to fit individual daily habits.

The plants must have been actively growing for several months before shading is applied. The schedule must then be followed for approximately a month, or until the buds are the size of a pea. This procedure will give you chrysanthemums in bloom when you want them.

The cuttings with which you start must come from good sound stock and you must provide the best of cultural care to obtain good results. Many fine chrysanthemum nurseries advertise in the National Chrysanthemum Society Bulletin.

The publication also contains much useful information for gardeners who are interested in chrysanthemums.**

How to Grow Chrysanthemums

The bloom forms of chrysanthemums may be divided into two cultural classifications. The singles, spoons and pompons are best grown as bushy plants which produce many sprays bearing three to ten blooms each. The so-called "football" chrysanthemums and spider types are developed with one, two or, at most, three large blooms on a plant which may grow as tall as six feet.

To give a simplified version of greenhouse chrysanthemum culture, let us assume we have some pompon chrysanthemum plants and some large bloom incurves which normally are in flower about October 25. These are plants which have wintered over and are making new vegetative growth in May. We want some in bloom to enter in a show on October 10 and we want some for Christmas.

A rooting bench in the greenhouse is our starting point. I use a sand-filled bench in which the sand is kept uniformly moist by means of an automatic ball-float-controlled system of water pipes buried in the sand. Lengths of 4 inches of the new growth are cut, dipped in rooting hormone, and inserted to a depth

*May be purchased from N. S. Smith Co., Box 272, Red Bank, N. J.

**The six yearly issues are included as part of the \$4 annual membership fee. Applications for membership, accompanied by the dues payment, should be addressed to the Secretary, Miss Dorothy P. Tuthill, 345 Milton Road, Rye, N. Y.

of an inch or slightly more in the sand. Under greenhouse conditions the cuttings will root in approximately two weeks. As soon as the cuttings have roots about one-half inch long they may be moved into 2- or 3-inch pots. Then, after several more weeks of active growth in the greenhouse or coldframe, the plants are ready to be shifted to 4-inch pots or directly into soil. Plants for the shading program may be grown in pots or in a soil-filled bench. In either case, be sure the soil drains well and is rich in organic material. Also provide a location where the plants will receive full sun and have room to develop.

About June 15 all the plants should be pinched. This means removal of the top half inch of terminal growth by cutting the stem with the thumb nail. From a point directly below the pinch two or three branches will develop. For bush-type plants we retain all of these branches, but for large-bloom types we remove all but the strongest.

During this active growth period a combination spray program with Malathion and Captan will control insects and disease. A feeding of liquid fertilizer will promote growth. Use metal or bamboo stakes to keep plants growing straight.

About July 15 all terminal growth should be pinched again. The resulting branches on the bush-type plants are retained, but only as many stems are kept on the incurves as the number of blooms desired.

Shading for Early Bloom

On August 1 the shading program is started for the plants that are wanted in bloom by October 10. Buds should be evident by September 1, although excessively high night temperatures in August may delay their development. All during the growing season, branches will develop from the lower leaf axils of the plants. On the incurves, side buds will form around the central blooming bud. All of this excess growth must be removed as soon as it is large enough to handle, so that all plant energy will be directed toward production of good terminal

sprays on the one kind and large well-formed blooms on the other.

Lighting to Delay Flowering

Plants for the lighting program are obtained either from cuttings removed from plants in the garden, or from extra plants grown in pots indoors for this purpose. Between July 15 and August 1 is the ideal time. The cuttings are rooted as previously described, but more care is required when rooting is done in hot weather. Light shading is desirable. Misting several times a day is a beneficial measure.

Although the normal short-day influence is not due to start until approximately August 15, to prevent premature production of buds, the plants will require extra light from the cutting stage until mature growth has been obtained.

One light fixture above the cuttings will be sufficient, but as the plants grow it may be necessary to use two or more lights. Also, as the height increases it will be necessary to raise the lights. The same good cultural practices previously described must be maintained.

The late October blooming chrysanthemums we are growing require approximately eight weeks of short-day influence. Therefore we count back eight weeks from the date on which we want full bloom and stop the lighting program then. November 1 would be the date to stop lighting in order to have blooms for Christmas.

(Continued from page 95)

tions, and build glass houses with a satisfactory heating system which could be regulated with precision, before such rare plants could be brought and kept in Northern Europe. In 1883 there were only five known species of the orchid *Odontoglossum*, but so great was the demand and so quickly was the plant discovered, hybridised and propagated, that by about 1900, one London nurseryman had a stock of 10,000; and at a sale of the stock from a Tottenham nursery about the same time, an American syndicate paid £24,000 for the whole stock.

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SEYMOUR D. VAN GUNDY, Department of Nematology, University of California, Riverside, California, once started a small cactus garden and now cultivates an acre of succulent plants as a hobby. He is the author of forty technical articles on nematodes and the diseases they cause in plants.

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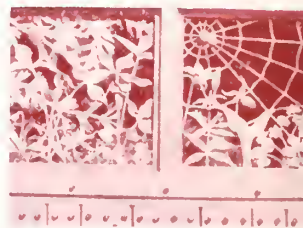
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No. 3

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Molly Adams

A rock garden planting of hardy succulents

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Imagine the internal workings of a plant that can live in a desert where there may be as little as an inch or so of rain in an entire year—and some years no rain at all. This life of water-denial may be one of the reasons succulents are so popular as house plants. With many species it is often better to forget to water them.

Some people feel that succulents are grotesque and unfriendly plants; others admire them for their architectural uniqueness, as well as for their water frugality and ease of culture. In any case, they are among Nature's unique developments, and by any measure must be classed with the ultra-specialists of the plant kingdom.

Many species of succulents are collectors' items, but hundreds of kinds are available from nurseries in many countries (addresses on pages 64 and 65). They offer an almost endless variety of shape and form, characteristics that are of interest throughout the year. While many of the illustrations on the pages that follow suggest that they spend a good share of their lives in blossom, the fact is that the flowers are short-lived. This is in the tradition of their desert upbringing, where a single brief rainfall stirs them from dry-season dormancy, a condition to which they soon return.

Edible fruit is the final product that follows the flowers of some succulent plants, and that of the prickly-pear cactus (*Opuntia*) is perhaps the best known. Sold in many markets, it is mucilaginous and seedy, yet "interesting" to eat. The minute, spiny hairs should be carefully avoided, and removed with discretion. One way is to hold the fruit on a fork and peel off the outer layer. An early 16th Century diary tells of Indian tribes of southeastern Texas depending on fruits of prickly-pears for food (see the "Odyssey of Cabeza de Vaca," by Morris Bishop, published by The Century Company, 1933).

As the manuscripts and illustrative material for this Handbook began to assemble, the windowed plants (David Hardy's article on "flowering stones," page 42) caught my special fancy. And from our living collections a few juicy *Fenestraria* leaves were sacrificed—I looked inside. The rough diagram on page 44 tells the story. What a lonely life the windowed plants lead with their leaves partially buried in the sands of South African deserts—with only translucent peek holes to the sky.

How did the succulents evolve? What kinds of relatives were their forebears millions of years ago? Did they adapt to the desert life with its deficient moisture, or were they simply among the multitudinous variations in plant form—that because of their special structure were enabled to move out into desert habitats? Whatever the case, they are among Nature's finest examples of species with "a will to live."

This is the fourth Handbook in our PLANTS & GARDENS series edited by Mr. Henry Teuscher. In every instance he has strived for excellence and accuracy, and the authors he invited to write on this very special subject deserve the warmest acclaim. Mr. George Kalmbacher and Miss Elizabeth Scholtz of the Botanic Garden Staff deserve special mention for their collaborative efforts with Editor Teuscher. And of course without Miss Woodward's tireless efforts, there could have been no Handbook.

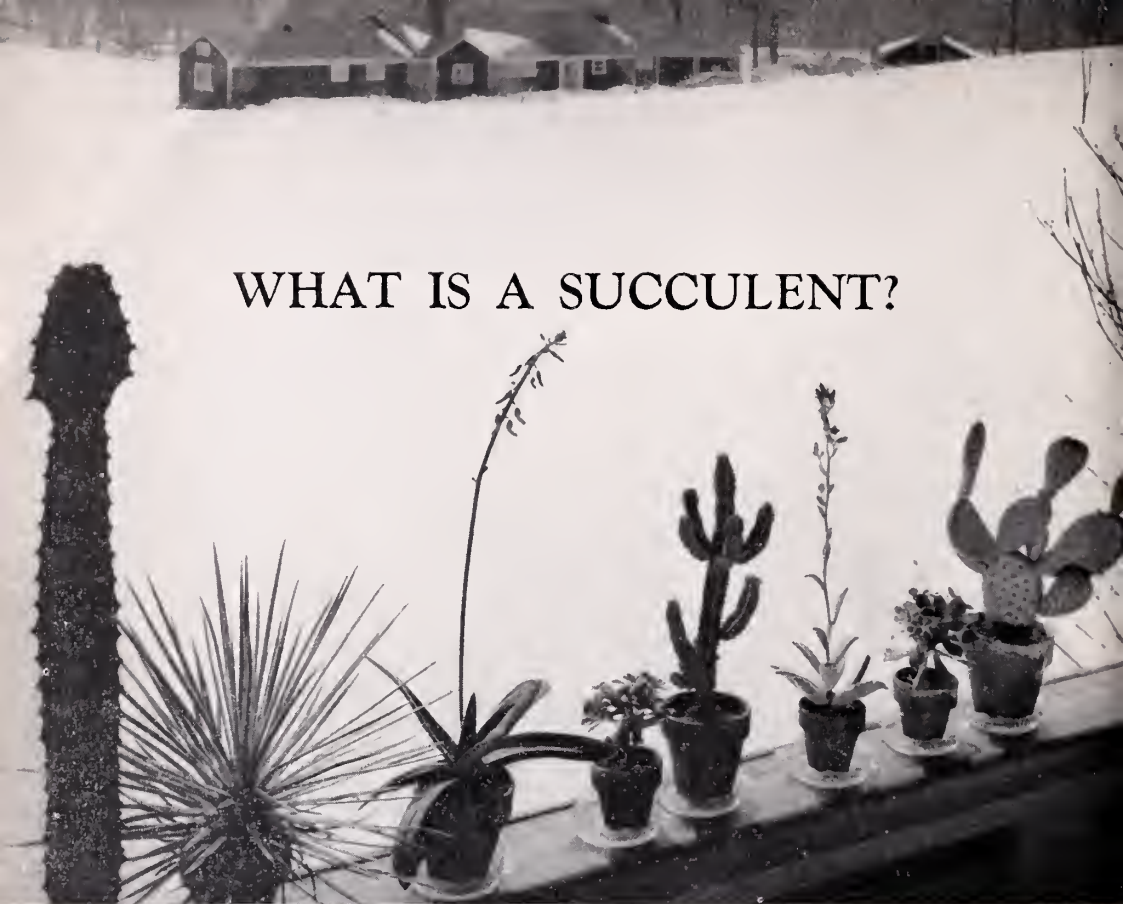
Don't trip over the scientific names—relatively few succulents have common ones. The index of common and botanical names (page 68) will, we hope, be helpful.

Sincerely,



Director

Erratum. The color picture captioned *Euphorbia stellaespinia*, on page 36, should carry the name *E. cereiformis*.



WHAT IS A SUCCULENT?

Roche

There are many shapes and sizes, many habitats

Henry Teuscher

THE term "succulent" when used as an adjective actually means "juicy" and is commonly applied in this sense in everyday speech. In horticulture, especially when used as a noun—"a succulent"—the term refers to plants which have fleshy leaves or stems or both; such fleshiness is not always accompanied by juiciness.

The plural "succulents," applied to a whole group of plants, has gradually come to designate plants from arid or semi-arid regions, which through extreme reduction of body surface limit their water-loss (botanically called transpiration). The odd and often grotesque shapes of

such succulents intrigue many plant lovers; these are the plants which are treated in this Handbook.

The main purpose of this explanation is to clear up the old and still persisting confusion which culminates in the ever-recurring question: "Is this plant (whatever it may be) a cactus or a succulent?" The question is nonsensical because cacti *are* succulents. The true cacti are members of the botanical family *Cactaceae* and are distinguished from the succulent members of other plant families, such as the *Euphorbiaceae* or the *Asclepiadaceae*, by the structure of their flowers. It therefore makes equally poor sense to call all

succulents "cacti." The above question should be: "Is this plant a cactus or some other succulent?"

Significance of Plant Fleshiness

Succulence (meaning fleshiness) in plants implies a capacity for water storage that makes survival possible during drought. In the world's various tropical and subtropical regions, the seasonal rainy period is frequently followed by several dry months which may be completely without rain. Such prolonged and periodically recurring drought is a serious threat to the life of the plants. A natural selection takes place in which only those with water-storing tissues survive. In this manner succulence has developed in the course of evolution.

When a gardener receives a more or less succulent plant with which he is not familiar, the degree of fleshiness of its leaves or stems can be used as a clue to the severity or the length of the dry period to which it is exposed in its native habitat. This will serve to aid in planning proper culture, because when a plant by inheritance is more or less fleshy, it is not only able to survive drought but it needs a dry rest period, whether in cultivation or growing in nature.

EPIPHYTIC CACTI. *Rhipsalis* grows on trees in the forests of tropical America. Above right, *R. warmingiana* is shown as a basket plant, growing in pure sphagnum moss and watered sparingly. Below, *R. houllettiana* in flower.



Montreal Botanical Garden photos

Little doubt can exist about the need of such a dry rest period as far as most cacti and South African succulents are concerned, but there are gradations, and not even all true cacti live under desert conditions. The exceptions are well worth noting.

Epiphytic Cacti

These are in particular the orchid cactus (*Epiphyllum*; also called *Phyllocactus*) and the Christmas cacti (*Zygocactus* and *Schlumbergera*), all with flattened leaf-like stems. Other examples are the species of *Rhipsalis* and their relatives, with slender cylindrical, narrowly angular, or sometimes flattened fleshy stems.

These cacti are epiphytes in their native habitats, usually living in partial shade on the branches of trees or on rock



faces. Though this may seem odd, the adaptation is readily explainable. The woodlands which these cacti inhabit may be quite wet at certain times but they are subjected to an annual and rather severe dry period of several months, from October or November to February or March (which is summer in the Southern Hemisphere). During this time, some of the trees shed their leaves. The cacti become

dormant, and the water stored in their fleshy stems tides them over until favorable growing conditions return.

Bog-dwelling Succulents

Still more curious are certain fleshy-leaved or fleshy-stemmed plants which inhabit areas that are periodically inundated and that remain water-logged and bog-like for varying periods. Though seemingly paradoxical, succulence serves to store water even under these conditions. What happens is that a water-logged soil contains little or no oxygen. Since oxygen is required to enable plants to absorb water, this condition results in physiological drought, in spite of the fact that plenty of water is present. It is like Samuel Coleridge's tale of the Ancient Mariner, adrift on the sea, who cried: "Water, water, everywhere, nor any drop to drink."

The decisive characteristic which produces this kind of adaptation is that the wet condition is only temporary: too wet at certain periods for plants without water storage to survive and too dry at other times for true bog plants which in



Reid Moran

Leafy branches of *Batis maritima*, a succulent plant that grows where land is periodically flooded. Pistillate (female) plant at left, staminate (male) at right.



Reid Moran

A solid growth of *Batis maritima* on a tidal flat on the coast of California,



H. W. Rickett

Dudleya farinosa, a rock-inhabiting succulent on a cliff along California's Pacific coast.

their cell structure have provision for oxygen to pass down to their roots. Plants without special adaptation to such a situation are smothered during the wet period, and for this reason such areas usually are treeless.

Tidal flats along the sea-shore, which are inundated several times during the year by exceptionally high tides, and where various more or less succulent herbs are able to subsist, are typical of this kind of habitat. In the southern United States, a few true cacti also live habitually under such conditions, though their habitats are inland depressions, rather than tidal flats. These cacti look very much out of place when observed while their habitat is at the bog stage, which it usually is for several months of the year. For them, strangely enough, the wet time of the year constitutes their dry resting period, while the dry seasons are most favorable for growth.

Rock-inhabiting Types

Certain succulent high alpine plants, such as *Sempervivum*, growing on ex-

posed rocky ledges, have evolved dense rosettes of fleshy, often hairy leaves, a development which protects them against the hot noonday sun and the drying winds of summer. Their rest period is in winter when they are usually covered by snow.

The Shapes of Succulents

The efficiency and effectiveness of the shape developed by certain succulents that live under severely arid conditions is demonstrated by the fact that almost identical shapes can be observed in plants of different plant families, living in widely separated parts of the world (though under very similar climate conditions). Cylindrical or globular plant bodies, for instance, are as common among the *Cactaceae* of the Americas as they are among the *Euphorbiaceae* and *Asclepiadaceae* of South Africa and Madagascar. In fact, some of the columnar cacti and euphorbias are startlingly similar in general appearance. Large, thickly fleshy though hard-skinned leaves, produced in a rosette, are found in the agaves (*Amaryllidaceae*) of



Roche photos

Succulents frequently look alike, even though in different plant families: *left*, a cactus; *right*, a euphorbia.

the Americas as well as in the aloes (*Liliaceae*) of South Africa.

Drought-Resistant Plants

A number of drought-resistant plants are frequently but erroneously termed succulents. In the wild they are often found in the same areas as the true succulents, and they can also be appropriately placed with them in group plantings. The familiar yucca of the southwestern deserts is one of these. Others in the Lily Family are the closely-related *Nolina* and *Beaucarnea*, mostly native to Mexico. Both have a rosette of slender sword-shaped leaves.

Some of the terrestrial members of the Pineapple Family (*Bromeliaceae*) which in nature inhabit arid or semi-arid regions are especially worth while for inclusion in a planting of succulents. *Pitcairnia* is one of the best, with showy coral-red flowers in *P. corallina* and *P. flammea*.

Plant Families

The phenomenon of succulence, or fleshiness, is much more widespread in the plant world than is generally realized. H. Jacobsen, in his three-volume "Handbook of Succulent Plants," enumerates (on page 30) some 44 plant families which have succulent members. Even this long list, however, is not complete and many more could be added.

The most important families omitted by Jacobsen are the *Cactaceae* (which his handbook does not cover), the *Orchidaceae*, the *Gesneriaceae* and the *Piperaceae*.

Large numbers of tropical orchids are true succulents, their fleshy, pseudobulbous stems serving as water reservoirs. Many also have thickly fleshy and hard-skinned leaves. Some of those with thin leaves shed their foliage during the dry period, which lasts for several months. Some do not develop leaves at all, or have only small leaves which are ephemeral.

In these the vegetative part of the plant may consist of only flat, greenish, very fleshy roots. Others are true xerophytes, living under desert conditions. *Oncidium onustum* of western South America, for instance, with short, very thick, hard leaves, is sometimes found growing epiphytically on tall cacti. The orchid *Eulophidium* of Madagascar, which likewise inhabits arid areas, has leaves as hard as if they were stamped out of metal.

The family *Gesneriaceae* includes the African violets (*Saintpaulia*) of East Africa, which have somewhat fleshy leaves and leaf-stalks, but there are other gesneriads which are even more strongly succulent. Outstanding are *Codonanthe* and many of the *Columnea* species of the Americas as well as most of the *Aeschynanthus* of Thailand and Indonesia. *Chirita sinensis* of China also is thickly and stiffly succulent.

The family *Piperaceae* includes the large genus *Peperomia*, which has many strongly succulent species.

In the Geranium Family, the South African succulent species of *Pelargonium*



Buhle

Some xerophytic plants (those that live in desert areas) are drought-resistant yet not fleshy. They grow and thrive under the same conditions as succulent plants. Above, *Hechtia argentea*, a Mexican bromeliad.

are odd and curious plants, most of them more noteworthy for their bulky stems or roots than for any aspect of beauty. *Pelargonium bouckeri* is one of the few with large clusters of striking flowers. These are of greenish yellow and purple, the petals deeply lobed and fringed.

As with the others, the flowers appear in late winter or early spring. When summer comes the plants shed all their leaves and go into a rest period.

Pelargonium tetragonum is of a somewhat different type, with comparatively slender, quadrangular, green stems and with flowers of rose and purple in early summer. After flowering it also loses its leaves.

The other succulent pelargoniums are divided into two groups, those with thick fleshy stems and those with fleshy tuberous rootstocks. The fleshy-stemmed kinds include the following species:

With hooked spines

<i>P. apiifolium</i>	<i>P. erithimifolium</i>
<i>P. carnosum</i>	<i>P. dasyphyllum</i>
<i>P. crassicaule</i>	<i>P. echinatum</i>

With swollen nodes

<i>P. ferulaceum</i>	<i>P. gibbosum</i>
----------------------	--------------------

With persistent leaf-stalks which become long spines

<i>P. oblongatum</i>	<i>P. spinosum</i>
	<i>P. polycephalum</i>



Buhle

The succulent peperomias, like *Peperomia dolabriformis*, above, are epiphytes and require the same treatment as rhipsalis—not that of the cactus at the right.

The tuberous-rooted species include *P. bowkeri*, *P. incrassatum*, *P. longifolium* and *P. tysoni*.

The treatment of succulent pelargoniums in cultivation is the same as that of other succulents. They require a readily draining, not too rich soil, and during their leafless rest period they should be watered only very sparingly or not at all.

Geographical Distribution

As can be expected from this outline, the geographical distribution of succulent plants is very wide. Actually, few regions



Avery

This rosette-shaped plant, *Aeonium canariense*, is a common wildling on the mountains of the Canary Islands.



Rickett

The cholla (pronounced "choya") (*Opuntia mohavensis* and several similar species) is a common type of cactus in the southwestern deserts of the United States. The ease with which its joints and spines become separated from the plant gives it the name of "jumping cholla."

of the world are completely without plants which, through more or less pronounced succulence, are enabled to sustain life during periodically recurring dry periods.

However, the occurrence of *extreme* reduction of body surface (without leaves as we usually think of them), resulting in the production of the plants which are generally termed "succulents," is quite naturally restricted to truly arid or semi-arid regions. The main centers of distribution of these plants are the arid regions of Madagascar, large areas of South Africa up to southern Bechuanaland, and parts of the Americas. These last include rather extensive areas of the southwestern United States, parts of Mexico, and the coastal regions of Central and South America. The coasts of the Mediterranean Sea and the Canary Islands also contain many interesting succulent plants.

ORNAMENTAL POSSIBILITIES OF SUCCULENTS

*Design-minded growers
will find versatility here*

Emily Brown

NATURE, in the process of developing functional design, has often carved the foliage of plants in unusual and fascinating shapes. Never more so than with succulents, which, because of their immensely varied and intriguing aspects, offer an exceptional opportunity to the designer of decorative arrangements of living plants.

The color of the leaves and stems of succulents varies from all shades of green to almost blue, from lavender to purple, from bright red to deepest brown, and from beige to white. All the tones are much affected in appearance by the intensity and direction of the light which strikes their widely differing textures. This variance must be considered carefully in grouping the different kinds with each other as well as with other plants.

The often stunning flowers of succulents, when used in plant arrangements, are an extra bonus, to be treated as more or less incidental in comparison with the year-round attraction of the foliage and stems.

The placement of the leaves of succulents occurs in many forms, including spiraled and paired and clustered. Even the rosette, one of the most common leaf arrangements, varies from open to tight and from flat to mounded. The leaves themselves may be roundish, oval, triangular, cylindrical or of other shape; their edges may be smooth, saw-toothed, wavy or frilled. Hairs, thorns, warts or spines sometimes modify the design. The whole plant is frequently sculptural in form, at times suggestive of abstract art.



Judith Brown

The strap-plant (*Aloe plicatilis*), a small tree in its native South Africa. Container-grown, it develops slowly. *Aeonium haworthii* is the companion plant here.

A grouping of succulent plants may be based on shape alone. Even when no consideration is given to color or texture, the designer has a wide choice of possibilities in the composition of interesting and decorative displays.

Ornamental Groupings Outdoors

While there are frost-hardy plants among the succulents, including cacti, it is only in warmer-than-average climates that the majority can be used outdoors the year around. Where they are suited to a situation they do not demand excessive care; but they should not be planted just because they can survive neglect. Some of them do indeed tolerate more ill-treatment than other plants, but under such conditions they will never be a credit to the gardener. Few, for instance, will thrive under overhead water-

ing. Most are tender to cold, and many are easily injured by strong sun. None will ever develop its full beauty when marred by pests.

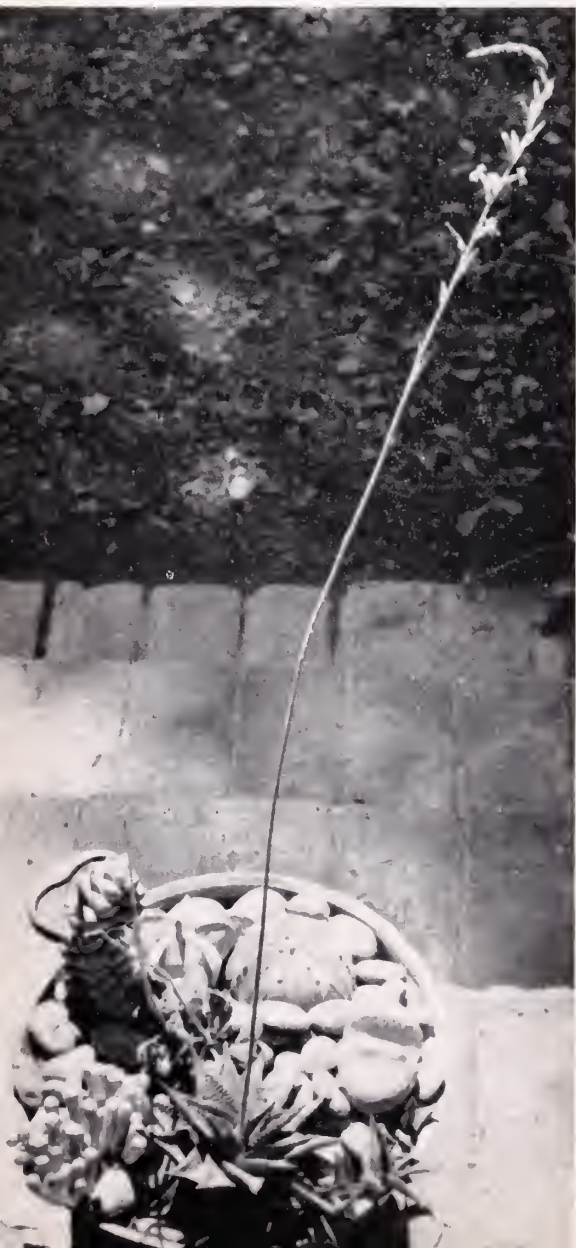
SMALL SUCCULENT MISCELLANY. Included are a windowed plant (*Fenestraria rhopalophylla*), *Crassula cornuta*, bishop's-cap and sand-dollar (*Astrophytum myriostigma* and *A. asterias*), a split-rock (*Pleiospilos neti*), *Haworthia limifolia* (in flower) and, center, *Andromischus cristatus*. Collection of Bern Catton, Los Altos, California.

The most important requirement of all cultivated succulents is perfect drainage. This can best be provided on a slope or bank, in a rock garden or a raised bed. For a pattern garden or a parterre planting, either for solid tapestry effect or in geometric outlines, a location must be selected where suitable growing conditions can be prepared artificially.

Whether planted formally or informally, succulents are generally most effective when kept to themselves, for few other plants blend with them satisfactorily. Exceptions are mat-forming types with little form, useful as ground covers. For the big succulents with bold outlines, the most pleasing companions are plants with a similar style as well as similar re-

Succulents thrive in a strawberry jar. At the top is an *Echeveria* hybrid.

Rosalind Wheeler photos





SUCCULENTS IN CONTAINERS. For names of plants, see footnote below.

quirements, such as drought-resistance. Species of *Yucca*, *Puya* and *Aloë* are examples.

Modern architecture, with its stark and simple outlines, often makes an excellent setting for groups of large succulents, including cacti, whether of a single variety or in a combination of several kinds. To harmonize the shape, color and texture of the plants with the background and surroundings requires observant study, and the general rules of good landscaping—that the fewer varieties used the better is the effect, and that the various groups should be interrelated—must always be kept in mind.

Succulents in Containers

The principles of ornamental container planting are much the same as those outlined for the garden. Here too it is necessary to practice restraint, and the safest procedure, even when dealing with fairly large containers, is never to combine more

than three kinds of plants. The colors must complement each other, and it can not even be assumed that all those of grayish tint go well together. The green that underlies the gray must be considered, and only greens that blend well should be chosen.

It is possible to use three kinds of plants of approximately the same height if, within the more or less symmetrically rounded mass, the individual shapes are in artistic association. However, the best effects are usually achieved when one larger, upright, tree-like or spire-like kind is selected as the dominant feature, with one or two smaller kinds as subordinates. Small containers are best planted with only one kind, unless a second is used as a ground cover. Or several miniature succulents may be selected and arranged in a varied mat-forming design in which no one plant predominates.

Addition of Inanimate Objects

Rocks of various shapes may be incor-

Left to right, above, top row: *Urbinia agavoides*, *Echeveria* hybrid, *Piранthus globosus*, *Echeveria derenbergi*, *Haworthia margaritifera*, *H. fasciata*, *H. bolusi*, *Echeveria* species, *Cotyledon ladismithensis*, *Stomatium* species, *Cotyledon orbiculata*, *Echeveria elegans*.
Second row: *Aeonium arboreum*, *Echeveria* 'Orpet's Chocolate', *Dudleya pulverulenta*, *Crassula falcata*, *Echeveria* crested hybrid, *Aloë aristata*, *Dudleya brittoni*, *Echeveria* hybrid, *Sedum spathulifolium*, *Echeveria hoveyi*, *Cotyledon orbiculata oophylla*, *C. orbiculata* hybrid, *Gasteria armstrongi* hybrid, *Echeveria crenulata*, *Cotyledon macrantha*, *Echeveria setosa*.
Third row: *Crassula arborescens*, *Echeveria* hybrid, *Echeveria* 'Orpet's Chocolate', *E. hoveyi*, *Dudleya attenuata*, *Pachyveria scheideckeri cristata*, *Echeveria elegans*, *Senecio jacobsoni* (*Notonia petraeus*), *Haworthia* species, *Echeveria* hybrid, *Kleinia tomentosa*, *Echeveria gibbiflora metallica*, *Echeveria crenulata*, *Pachyveria* 'E. O. Orpet', *Echeveria gibbiflora metallica*, *Crassula falcata*.



Judith Brown

Container-grown succulents by the sunny doorway of a warm-climate home. For names of plants see footnote below.

porated in a container arrangement for naturalistic effect. A really handsome rock of interesting shape may even be the largest object in the container. In general, however, rocks and stones should remain subordinate to the plants. More or less flat shapes are best, though the jagged point of a rock may be introduced to repeat on a smaller scale the upward thrust of a spire-like plant. All rocks should be partly buried to give the appearance of outcroppings. One should beware of bits and scraps of material other than rocks.

Larger specimens above, *Kalanchoë beharensis*; leaves are velvety gray with rusty hairs. The two terra cotta bowls at left contain *Kalanchoë tomentosa*, their densely-felted white leaves tipped with brown. Accompanying rocks are dark-speckled gray. On the top step is *Echeveria pulvinata*; stems are brown felted, leaves grayish-green, tipped red; flowers are a clear terra cotta that blends with the brick. The lower bowl contains *Echeveria simulans*, the rosettes a pale blue-green.

Types of Containers

As a general rule, the outline of the container should be plain. Only when the container itself is the dominant feature of the design is it appropriate to have it fluted or otherwise ornate. Square or rectangular containers should be avoided. Curved or rounded ones are more suitable because most succulents have a more or less rounded look.

The depth of the container may be anything from a shallow platter to a tall urn. The platter may be planted with shallow-rooting kinds, while the urn might accommodate a tall or wide specimen, or a close fitting mass, resembling a lid.

A container with a rough outer surface is usually more aesthetically satisfying than one with a smooth surface. A heavy substance is more pleasing than a light one. Substantial or worn material gives the impression of permanence.

The color of the container should always be subdued. A monotone is preferable to multicolor. Dark tones, as in iron or copper, are often pleasing foils.

Various types of hanging baskets may be used. Invisible ones can be made of wire mesh stuffed with moss.

Many ornamental containers have no provision for drainage. The secret of keeping the plants growing well is to give them only a very little water at a time—just enough for their immediate use.

How to Display

The best place for succulents in containers is outdoors, especially in summer. If kept indoors, they must be given as much light as possible.

They are most decorative when they are kept well groomed. As the oldest leaves begin to wither, they should be pulled away. As an offshoot forms in an undesirable direction, it should be removed. The more the plant excels in structure and texture, the more these two qualities need to be preserved by constant attention.

STAPELIADS

*Conditions under which they
grow and how they
should be cultivated*

David S. Hardy

THE stapeliads are a group of low-growing, cactus-like succulent plants in the Milkweed Family, most of them natives of South and tropical Africa. Because of their scent when they bloom, many are called carrion-flowers. The angular and tubercled plant and the shape and coloring of the flowers give them an unusual appeal to the plant hobbyist. Yet they are only scantily known in cultivation.

Among the carrion-flowers, *Stapelia variegata* is the one most generally cultivated. It also is perhaps the most variable. The natural habitat of this attractive species is from Cape Town to Lamberts Bay on the West Coast and as far afield as Mossel Bay in the South. Plants take kindly to cultivation and, though they will thrive in almost any soil, do best in a light sandy loam. In the Southern Hemisphere, the plant should be watered during autumn and winter and very sparingly at other times. Because of the reversed seasons, this is exactly opposite from the practice in the Northern Hemisphere.

Soil Mixture

Stapeliads in general do best in a slightly alkaline soil (pH 7.2-7.5). The only exceptions appear to be some species of *Hoodia*, which grow in nature on dolomitic limestone formations, where, because of the low rainfall, the soil has a pH of 8 or more.

A satisfactory soil mixture consists of the following: $\frac{1}{2}$ coarse river sand, $\frac{1}{4}$ clean, well rotted compost, $\frac{1}{4}$ clean garden soil, preferably a light loam soil. To this mixture may be added a teaspoonful of raw rock phosphate, which becomes available to the plants gradually.



Division of Botany, Pretoria

This curious carrion-scented plant is *Stapelia revoluta*, of the Milkweed Family (natural size). It grows wild in South Africa.

Such a soil mixture usually contains sufficient amounts of the trace elements required by stapeliads, but it has been found that copper, cobalt, iron and magnesium are particularly important. These should be added twice a year during the growing season.

For best results, the plants should be repotted every year. This not only gives them fresh vigor but also offers the grower an opportunity to cut away any diseased portions and to destroy root pests.

For species of *Trichocaulon* and *Hoodia*, the upper soil layer should consist of a mixture of charcoal and coarse river sand,



Colin K. Richards

The dramatic flowers of *Stapelia hirsuta* are 5 inches across, cream-colored and hairy, with zebra-like stripes of purple. Petals are bordered with long white and purple hairs.

so that only the roots are in contact with the soil. This will prevent infection of the stems by bacteria and fungi.

Pots and Containers

In a warm climate, metal containers are recommended, because they neither dry out as quickly nor harbor as many insect pests as clay pots do. Such metal pots should have a loose bottom which can be pushed up from below for the removal of the plant. This permits examination of the roots without damaging the plants, and also makes repotting easier.

Shallow asbestos trays are best for plants which form large clumps.

Propagation

Most succulents are best raised from seeds. In growing stapeliads, seeds should be sown as soon as possible after ripening, for their period of viability is relatively short.

The soil mixture for seed sowing is the same as that recommended on page 14 for mature plants. After sowing on a level surface, cover thinly with a layer of coarse gravel, press down firmly, and keep damp until germination is complete.

Unless precautions are taken, damping-off, caused by a fungus, may occur after a few days. This can be prevented by watering three or four times a week with the following solution, until the damping-off stage is passed:

1 teaspoonful Captan 406

1 teaspoonful Ferbam

1 teaspoonful P.C.N.B. [pentachloronitrobenzene, sold as Terrachlor]

These ingredients are dissolved together in a gallon of water.

Diseases and Pests

Virus infections, which may cause considerable damage to cultivated plants, are best prevented by destroying the virus-carrying aphids or root-bugs. A weak solution of liquid soap, sprayed or poured on infested parts, is usually sufficient to destroy aphids.

Woolly aphids or root-bugs are the pest most frequently encountered on stapeliads. This plague, which sometimes appears almost overnight, attacks the plant above ground as well as on the roots. Delicate plants often rot or die off within a day or two.

One way to prevent such an infestation is to add a teaspoonful of tobacco dust to the soil of each container. Even cigarette butts, broken up around the roots, are effective.

Hints on Culture

Fresh air is an essential factor in the cultivation of succulents, and stapeliads are no exception. Plants which are grown

Caralluma aperta, a native of Namaqualand. Some carallumas have underground stems which remain alive when the above-ground portions are dead from drought.

Hardy



in stagnant air, with poor ventilation or none, usually die off or at least refuse to flower.

[This note is well worthy of attention, because the information applies also, to a very large extent, to other South African succulents.—Ed.]

* * *

Regardless of when the periodic rains occur, all the regions in which stapeliads are found have one climatic factor in common—a long dry season during which the plants dry out considerably. It is essential that also in cultivation they be given a similar dry spell for “rest.” Plants that are forced into growing throughout the year rarely flower sufficiently to be of interest to the gardener.

* * *

In Namaqualand, the rains fall during winter, and flowers appear in early spring. In the semi-arid regions of the northern Transvaal, stapeliads flower during autumn.

* * *

Some species of the genus *Hoodia* occur in regions where the annual rainfall averages less than 2 inches. Sometimes, several seasons pass without any measurable amount of rain. Under such conditions the plants blossom hardly at all, apparently needing all their reserves of energy for survival. It may also happen, however, that after heavy rains the plants lie for days on end half submerged in water. This occurs occasionally after intense and long-lasting drought and does not seem to be injurious to the plants.

The long creeping stems of *Stapelianthus pilosus* bear small five-pointed speckled flowers.

Botanical Research Institute, Pretoria



Division of Botany, Pretoria

Frerea indica is the only stapeliad with normal-looking leaves. Note the small dark star-shaped flower. Found wild in Bombay Province, India. In cultivation, requires more water than other stapeliads.

Trichocaulon pedicellatum occurs in one of the most arid regions of the world, the Namib desert on the west coast of South-West Africa, where the plants grow in sandy ridges among masses of black rock. Most of the moisture required by these plants derives from the heavy sea-mists which blow in from the Atlantic Ocean.

Trichocaulons nearly always grow in rocky areas, where the surface covering of rocks prevents the soil from drying out too quickly after rain has fallen.

* * *

Some species of *Caralluma* have long underground stems to conserve moisture during the dry season. In periods of severe drought, the surface portions often die away completely and only the underground stems remain to produce fresh growth after the first heavy rains.

* * *

With the exception of plants in the genus *Hoodia* and some species of *Trichocaulon*, stapeliads as a rule are shade-lovers. In the wild they are often found under small bushes or trees, or in the grass.



HYBRID EPIPHYLLUMS AND THEIR RELATIVES

Their forebears lived in the trees

S. E. Beahm



Genereux

The broad green leafless stems of epiphyllums produce an abundance of flowers.

IF looking for something more colorful than some of the everyday house plants, indoor gardeners may wish to try epiphyllum hybrids. This spectacular group of spineless cacti is becoming increasingly popular.

Scarcely more than a century has passed since the tropical American jungle

species of *Epiphyllum*, mostly with white flowers and nocturnal blooming habits, were first crossed with highly-colored species of the sun-loving Mexican genus *Heliocereus*. But only in recent years have the results of the patient work of the pioneers and later hybridists come to be appreciated by the general public. The vibrant color combinations and wide range of flower sizes and forms seem endless.

Watching the tiny pin-point buds develop in a couple of months to giant size has a great appeal. Some of these buds will open into 8- to 10-inch disc-like blooms; others into enormous trumpets with a ring of sepals in contrasting colors; or into a cup-and-saucer shape with an inner ring of shimmering electric blue. Among the innumerable color combinations the only lack is a true blue.

The same is true with the small-flowered varieties, which are just as beautiful in their way and often bloom more abundantly. These are especially useful for corsages.

How to Grow Epiphyllums

Culture is relatively simple. Remember they are hybrids of an epiphytic tropical cactus—one that had its home in the trees. They prefer partial shade, that is, conditions suitable for ordinary ferns or begonias, though they must not be kept quite as moist.

The epiphyllums have a small root system, considering the size of the plants. Therefore it is essential that they be given a fairly rich growing medium to nourish the plants. However, the needs of these cacti are easy to meet. A good potting soil consists of equal parts of leaf mold (compost), well-rotted steer (cow) manure, gravel (to $\frac{1}{4}$ inch in size) and

garden loam, supplemented with 1 cup of bone meal to each 5 gallons of the mixture. Other proportions will also produce good plants as long as the mixture is fairly coarse and loose. Charcoal is sometimes added but it is not essential.

Uses of Plants and Flowers

Select your plants to fit the spot you have for them. Some varieties are suitable for espaliering. These branch low and produce reasonably long branches. Train them as they grow. Set them where they can have free air circulation, not next to a hot wall where they will get burned by reflected sun-rays. Two varieties suitable for espaliering are 'Hermosissimus' and 'Padre.' When hanging baskets are desired, choose small-flowered types which have pendent branches, such as 'Rosetta,' 'Bambi,' or 'Red Kaiserin.'

Flowers last for several days after they are fully open. Cut flowers for decoration keep well in a bowl when they are set in moist but not wet sphagnum moss. In this way the moisture rising directly under the sepals and petals tends to keep the flowers fresh longer than when they are propped up in a vase.

If you want to keep a flower to show a week or so later, slip it gently into a wide-mouthed jar as soon as it is open (very early in the morning), place the lid on tight and set it in the refrigerator. Do not put water in the jar. A damp bit of cotton or moss around the base to hold the flower upright is all that is needed. By keeping the flower cool, dark and tightly enclosed (to check evaporation from the petals) it remains in good condition.

Propagation and Potting

Cuttings are best for raising new plants. They should be set not more than 1½ inches deep in a mixture of leaf mold, peat and sand. (One of the soil conditioners such as Perlite, Sponge-Rok or vermiculite may be used in place of sand.) They may be held in this mixture for several months before potting.

When well rooted they should be planted in slightly damp soil (moistened sev-



Beahn

Epiphyllum 'Padre' has long lax stems which make it a suitable candidate for espaliering or other training.

eral days before using). Withhold water for several days to a week after potting. These directions also apply in the repotting of older plants. Do not repot plants until after their blooming season is over; but not later than October. They start to show buds in January, and if disturbed while these buds are forming, the plants will not do their best for you when flowering time arrives again.

Raising new varieties from seed is a slow process. While seeds may germinate in from 7 to 10 days, it will be 6 months



Teuscher

Stems of Christmas cactus arch gracefully from a hanging basket. Its pendulous branches will bear colorful fruits if the flowers are cross-pollinated with those of another clone.

before they can be transplanted from the seed jar to community pots. Not for another 6 months can they be moved to individual pots. To reach flowering stage takes from 5 to 7 years.

In a program of breeding and selecting choice varieties, the next step is to choose the finest ones from among thousands of seedlings. By propagating these through grafting and from cuttings, a grower eventually obtains a sufficient supply of a chosen variety to name and sell. Under the auspices of the Epiphyllum Society of America,* names of new varieties are now registered. This system avoids duplication.

Choice Kinds to Grow

Among the varieties of epiphyllum hybrids worth recommending are these:

*S. E. Beahm, Registrar, 2686 E. Paloma Street, Pasadena 8, California. Secretary of the Epiphyllum Society is Mrs. Gene Luekenbacher, 4400 Portola Avenue, Los Angeles 32, California.

- Gloria—clear salmon orange
- Conway Giant—rich purplish red
- Golden Gleam—bright orange, cerise at base
- Eden—large white, yellow outside.
- Parade—pink
- Rosetta—rose-pink basket variety
- Scheherezade—light to dark magenta
- Karl Gielsdorf—light orange, rose edges
- Amber Queen—giant, amber and red
- Flamingo—orange, cerise edges
- El Indio—very large, tomato red with darker eye
- Hermosissimus—red and lavender inside (old favorite)
- Augusta Von Szombathy—reddish orange outside, pale silver lavender inside
- Nocturne—bright purple outside, almost white inside
- Sweet Prince—blend of red and purple.
- Royal Rose—rose-buff

The Christmas Cactus

The winter-blooming plants most commonly called Christmas cactus, but also lobster, yoke or crab-claw cactus, were formerly included in the genus *Epiphyllum*. Since the publication of Britton and Rose, *The Cactaceae* (1919-1923), they have been known as *Zygocactus* and *Schlumbergera*. The many intergeneric hybrids sometimes make it difficult to assign cultivated plants to one or the other genus.

These plants are natives of the warm moist forests of South and Central America, where they grow on the branches of trees, similar to tropical orchids. In consequence they like a shady location or a sheltered position away from drafts. In the house they need plenty of light but not direct sun through a window.

The crossing of *Zygocactus truncatus* with *Schlumbergera russelliana* has produced many hybrids with flowers in varying tones of pink, violet, orange and white. *Schlumbergera gaertneri* (*S. makoyana*) with its varieties, blooming in the spring, is often known as the Easter cactus.

A well-drained potting mixture such as is used for the epiphyllum hybrids or for other epiphytes from tropical zones

(Concluded on page 24)

WHAT IS A CACTUS?

*Briefly, any plant
belonging to the
Cactus Family;
no other plants
are known
as cacti*

George Kalmbacher



Roche

OF THE more than three hundred different families of flowering plants, the Cactus Family is one of the most striking, distinctive, diversified and specialized. It includes about two thousand different species; all are perennial and succulent. Their usually conspicuous flowers are so different from those of all other plant families that the cacti stand unique and alone, without obvious relationship to other plants. This remoteness from other plant life, coupled with our lack of knowledge of their ancient lineage, makes their place in the evolutionary relationship of the plant world a matter of some uncertainty.

The family spans the two American continents, North and South, from Alaska to Patagonia. Most commonly inhabiting semi-arid or near-desert regions, cacti also

The flowers of this yellow-petaled *Opuntia compressa* and of other members of the Cactus Family are strikingly alike in structure, even though different in color.

can be found growing in altitudes that range from the seashore to thousands of feet above sea level in the Andes Mountains. In the United States, species of cacti are found in all the states except those of northern New England. In the Southwest, a striking feature of the desert landscape is the tree-like saguaro—or sahuaro (*Carnegiea gigantea*).

In addition to the species which inhabit arid regions, there are forest dwellers that live for part of each year in a moist habitat. Most of these grow perched on trees, as epiphytes. Some are vine-like; some produce long straggling or drooping shoots.

The distinctiveness of the family shows itself not only in the flower structure but also in one characteristic that, although possessed by every cactus plant, is absent in all species of all other families. This is the spine-cushion, or *areole*. Whether or not spines are present, all cacti have areoles at all times. This is one way of distinguishing them, for these areoles differ in structure on different kinds of cacti.

All flowering plants have joints on their stems which are called *nodes*. The leaves arise at nodes, and buds are also found at nodes.

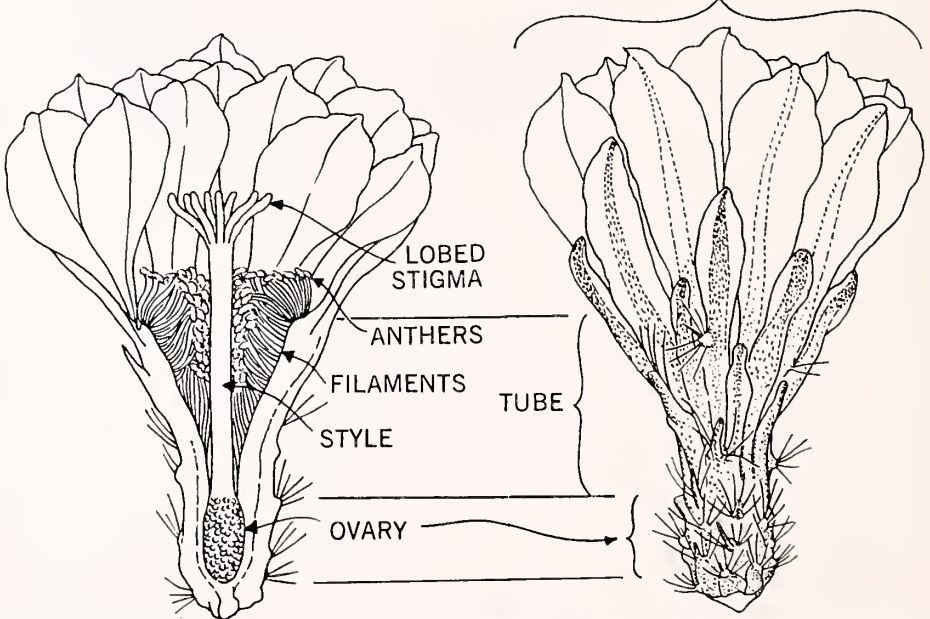
In the Cactus Family, the areoles occupy a similar position, and it is at the base of these areoles that leaves are borne. (It is not commonly realized that many cacti have leaves, because they are generally so minute and short-lived that they are seldom observed.) Buds spring from the areoles, both those that will open into flowers and also those that will develop into branches.



A CACTUS IN BLOOM. The flat pad of a prickly-pear (*Opuntia*) is the stem of the plant. The little clusters of spines and other minute outgrowths are areoles. These structures, together with small succulent short-lived leaves mark the nodes, which are spirally arranged; hence the distance between one areole and the next is an internode.

Drawings by Eva Melady

PERIANTH



STRUCTURE OF A CACTUS FLOWER (*Echinocereus papillosus*). Left, longitudinal section through the flower; right, external view. The petals are frequently of indefinite number, and here, as in many other cacti, they grade into the sepals with only slight distinction. Petals and sepals together form the perianth. Stamens, consisting of anthers and filaments, are numerous. The stigma (the central portion which receives pollen from the stamens) is divided into several lobes.



TYPES OF AREOLES. Minute spines, bristles, and silky and woolly hairs occur in different combinations in the areoles of different species of cactus. They vary greatly in size, design, rigidity and color. *Left*, erect central spine and numerous radial spines of *Melocactus oaxacaensis*. *Center*, areole of *Notocactus* with spines embedded in woolly hairs. *Upper right*, hooked central spine and three radial spines surrounded by silky hairs in *Mammillaria*. *Lower right*, two barbed bristles (glochids) and a woolly hair from *Opuntia*, magnified 50 times.

Other structures besides leaves, flowers and branches are associated with areoles. These small but complex areas may include spines, bristles, long hairs, woolly hairs and glochids (bristles to 1/10 of an inch long, set with vicious barbs of microscopic size), all together or in different combinations according to species (see illustrations).

The cactus flower is often highly colored, silky-textured and large. Its numerous petals and sepals grade into one another with little mark of separation be-

tween them. The accompanying sketches illustrate the parts of a typical cactus flower.

Most cacti come into bloom in the daytime. These are mostly the colorful ones, but they have no scent. Some cacti—in certain genera all the species—open at night. The flowers of night bloomers are generally white and very fragrant. The so-called “night-blooming cereus” (a name applied to several different kinds) belongs in this category. Another night bloomer is the giant cactus, the saguaro.



CACTI HAVE LEAVES

ALTHOUGH cacti are generally looked upon as leafless plants, all have leaves of some sort, and many have noticeable foliage on the young growth. Young stems or "pads" of the opuntia cactus, for example, have small succulent leaves, one at a node. They are short-lived and soon drop from the maturing pad.

Two genera in the Cactus Family bear normal-appearing leaves which remain on the plant for a full season. Both have woody stems (as do many other cacti). The leafy shoots on well-grown plants, however, are strongly succulent.

One of these genera, *Pereskia* (sometimes spelled *Peireskia*), includes about twenty leafy shrubs, small trees and vine-like species. They have spines but none of the other areolar structures in the axils of their leaves. The flowers are distinguished from those of other cacti by their stalks. (See color illustration, page 35.)

Being rather awkward and unwieldy in their growth, pereskias are seldom planted for ornament, though a few, including the lemon-vine or Barbados-gooseberry (*P. aculeata*) are sometimes grown for their fruit. Their chief use is as a grafting stock for other cacti, especially the Christmas cactus. (See article "How to Graft Cacti.")

Pereskopsis is a somewhat similar genus containing about ten shrubby and treelike species. These have both spines and barbed bristles (glochids) in their areoles. The flowers are stalkless, like



Rickett

Small succulent leaves occur at the tip of a young stem of *Opuntia*. They fall off as the broad green stem matures.

those of *Opuntia* and most other cacti.

In their native Mexico and southward, *pereskopsis* is often planted as a hedge.

Cultural requirements are the same as those of other cacti.

(Continued from page 20)

is most suitable for these plants. Keep them moist through their active growing period. When growth slackens allow them a rest period with less water to induce the hardening off of new growth. Resume watering when buds are well developed. Flowers will appear at the tips of the arching, leafless, green branches. On the West Coast the flowering period may be two months earlier than in the East.

Varieties of worth which are now available include:

- Bicolor**—white and pink (Thanksgiving)
- Delicatus**—white
- W. A. Manda**—red
- Salmoneum**—salmon orange
- Violaceum**—violet
- Bahia**—upright grower, pink
- Pink Perfection**—one of the best pinks

The Christmas cacti give great reward for a small amount of care.

HARDY CACTI

Many kinds thrive in a South Dakota garden

where winter temperatures may drop to 40 degrees F. below zero



Opuntia polyacantha is one of the prickly-pear cacti that ranges widely over the heavy clay soil of southwestern South Dakota. The flowers are clear yellow.

All photographs by the author

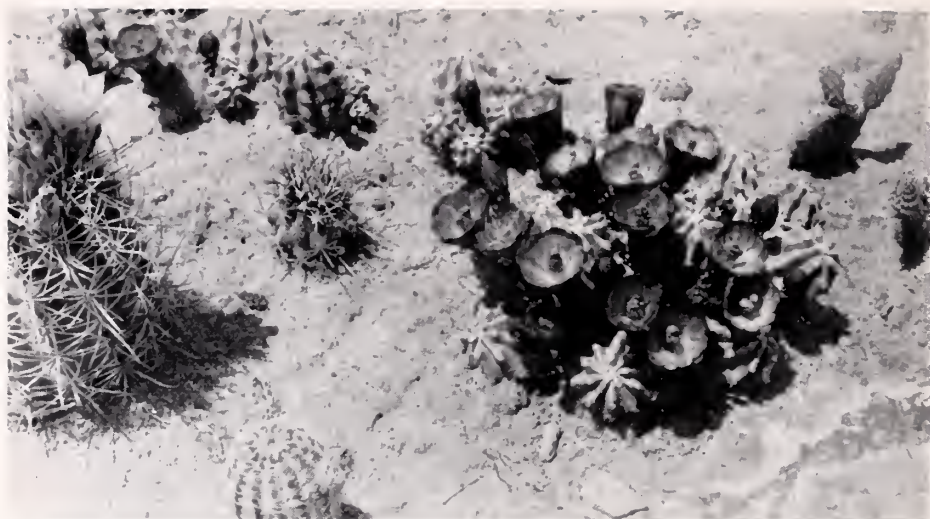
Claude A. Barr

CHANCE and only a slight acquaintance with soils put me down in a cactus patch many years ago. It was a case of making the best of it. And, unlike countless other homesteaders of that early day, I have stayed. So have the cacti, and I have taken them into my heart—as well as their spines into my fingers and toes.

Without detail as to ecological relationships of men and cattle, grass and cactus, suffice it to say that the heavy Pierre clay of southwestern South Dakota—and in fact of major portions of the Great Plains from Texas and New Mexico to the Saskatchewan River far up in Canada—was found adapted to livestock ranching rather than to general cropping. And so the

cacti remain free to occupy their native haunts under no greater jeopardy from the hooves of modern meat animals than of the former vast herds of bison.

On such soils about my home the prickly-pears, *Opuntia polyacantha*, *O. humifusa* and *O. fragilis*, are so frequent that one learns to walk, sit and kneel in the wide outdoors with an eye to cactus. Cattle avoid their patches in grazing and a horse given free rein will often turn aside. The ball types, *Coryphantha vivipara*, *Neobesseya missouriensis* and *Echinocereus viridiflorus*, are more rare and are to be looked for on loamy or sandy soils and in stony places. Obvious hybrids of *Opuntia polyacantha* with *O. fragilis* or *O. humi-*



For intensity of scarlet coloring in the flowers, *Echinocereus triglochidiatus* stands supreme. The thornless variety *inermis* is shown here. In the foreground is *E. reichenbachii*. At the left, *Sclerocactus whipplei* can be seen in flower. This Colorado species is self-seeding under cultivation in South Dakota.

fusa with *O. fragilis* are often found, some with definite garden interest.

Weather Conditions and Hardiness

Survival hazards, here at 3200 feet above sea level, are a very occasional 40 degrees below zero in winter and summer temperatures quite regularly well above 100. Farther to the west where the Plains rise above 6000 feet elevation and also to the north, winter temperatures of 50 degrees below zero are not rare. To be considered also are rain and snow, wind, sunshine and low humidity. Our annual precipitation is under 17 inches. Drying of plant surfaces and of the ground is rapid at all seasons and to the liking of the plants. Compensation for such aspects of habitat needs to be diligently sought when cacti are being cultivated in more humid climates. Surface and sub-surface drainage and sun are the chief means. A plant that will endure 40 degrees below zero is good for any temperature, so far as I know, and I have sent cacti to some very cold places. A test is now under way in far northern Alberta, a latitude where only *Opuntia fragilis* is known to range.

Hardy cacti are not confined to the Plains region. The prickly-pear of the East, *O. compressa*, extends into Ontario, and *Pediocactus simpsoni*, ball to cylindrical, into Washington state. Both are hardy here. Various more southern ranging species have made their way to such plain and mountain elevations as to have acquired hardiness sufficient for most gardens.

To my collection of outstanding local forms has been added *Opuntia imbricata*, sometimes known as *O. arborescens*, from Colorado. Though it is native on the Plains only from the latitude of Pikes Peak south, it has passed 27 degrees F. below zero here. A villainously spiny *O. rutila* hybrid named 'Apache' has come from the D. M. Andrews gardens at Boulder, also a brilliant carmine-flowered form of *O. polyacantha*. Whatever this climate has dealt them, both have been good.

Cacti in a Test Garden

Through the good fortune to be chosen by a California hobbyist to make hardiness tests from his 1200-plant collection, my garden has gained many fine new kinds. Three out of 32 strains of *Opun-*

tia phaeacantha of varying origin are well adapted here. Two forms of *O. basilaris* persist, one of them blossoming after a night of 23 below in January when it may have had some snow cover. There are an *O. rutila* of fine carmine flower and complete hardiness, a spiny *O. rhodantha*, which is a handsome plant with a nice carmine blossom, and a spineless *O. rhodantha* with a most wonderful blossom of pink. An *O. rhodantha* with purple-tinted pads, deep purple in winter and with nearly black spines, is an eye-catcher. *O. aurca* is a spineless marvel with brilliant yellow flowers. Others have proved adequately hardy but of less attraction, some retained, some discarded. A number have failed to adapt and I have thought that for some the stumbling block may have been drought rather than temperature. A regretted loss was *O. polardi* from Mississippi, a plant of bright green, the pads only 2 inches or so wide, its strong yellow flowers carrying a patch of crimson in the center. It flowered freely over several years, then failed in a series of dry years.

An undetermined species *Opuntia*, by way of my California friend, has a large and wonderful flower of clear and crys-



Echinocereus reichenbachii has proved hardy in South Dakota. The many ribs on its cylindrical stem show a lace-like pattern of spines. Its large flowers come in purple tones.

talline carmine. I rate it among my greatest treasures though the margins of the pads where blossoms arise sometimes sustain frost injury. A small-jointed opuntia of cylindrical form, *O. whipplei*, is a prodigy of perseverance, sprouting new growth freely after freezing of the upper portions the last two winters. It came from 5000 feet elevation in Arizona but apparently is safe in only our milder winters. The tree-like *Opuntia davisi* from the high cold country of southwestern Colorado would surely be hardy here, but I have not had this plant.

For sheer intensity of color, mainly scarlet, also for novel form and good behavior, hardy varieties of the *Echinocereus triglochidiatus* complex can have few or no equals. This name is taken to include what have been known as *coccineus*, *gonacanthus*, *roemerii*, *inermis* and others. While plants vary in details of ribbing and spines, flowers are all much the same. Blossoming brings daily inspection and enjoyment.

Sclerocactus whipplei, a cylindrical fish-hook type belonging to southwestern Colorado, has grown well for many years, and a few self-sown seedlings are coming on. It has nice flowers of light reddish purple. *Echinocereus reichenbachii* and *E. baileyi*, many-ribbed, finely spined like lace work, with lavender to red-purple blossoms are both hardy. I have one under the name of "*E. albispinus*" that seems not different from *E. reichenbachii* except for its showy whiteness.

Variants and Hybrids

Other hardy kinds could be listed, but the casual gardener would simply regard them as other yellow-flowered prickly-pears. Yet one may select among our South Dakota forms of *O. polyacantha* alone a dozen variations of individual garden value. Species vary so much that as Lyman Benson has stated in *Cacti of Arizona*, it is often impossible to say whether an individual belongs to one species or another. The cactus layman is on safe grounds when he holds out for a plant that has distinct garden value and is pleasing to his taste.

How to Handle a Cactus

EVERY cactus fan learns somehow to handle the plants—not always safely. A visitor reached for a prickly plant. Quickly I warned, “Oh, don’t touch that.” “I always pick them up that way,” she said, and she did! But my own touch is not so trustworthy. Often I’ve tried pinching a few spines together for a handle. Then used two flat sticks managed like chop sticks. Something like sugar tongs of larger size should be right, I reasoned. Mentioning it to a friend, he brought out his “doughnut lifter,” or chef’s tongs, an instrument about 10 inches long with spoon-shaped jaws, hinged and with a spring to open them. The difficulty was completely cleared. You don’t have to stand back for spines.

In gardens where many kinds are grown in proximity, bees and flies and beetles really give the flowers a working over, and puzzling new things may result. Do not be surprised if your seedlings of *O. aurea*, for instance, come with strong spines. They will not be pure *aurea*, but hybrids. I have a great curiosity about variants and often let them grow on to flowering. Something new and beautiful could come.

Catering to Cactus Needs

Since my garden is in natural cactus

country, might not one fairly expect to succeed with any hardy cactus simply by acquiring the plant and setting it out? On the contrary, a modification in soil or position has now and again proved a second trial worth while. Set in unadulterated prairie gumbo, my highly valued carmine *Opuntia polyacantha* barely lived through two or three years. Moved to a sand bed—an excavation in the heavy soil 4 inches deep, filled to ground level with sand containing a faint amount of humus—at once it thrived and flowered freely and has continued to respond to that simple treatment through 25 years.



Opuntia fragilis in an exceptionally fine flowering strain of this South Dakota native, which should have garden interest in cold climates elsewhere.

Such a bed has proved out well for propagation, too. Any new plant introduced to the garden is given at least equal accommodations.

In building a display bed the excavation was deepened to 5 inches. Four inches of sand were laid upon an inch of compacted half-decayed compost. There is of course the mineral-rich clay within reach of deeper roots. This has worked well, though I find that most of the ball and cylinder types prefer a still better soil. A further successful modification has been accomplished by adding 10 per cent by volume of peat moss and an equal measure of limestone chip and dust to the sand. All kinds tried in it have flourished. I have not found the need of further experiment.

In moister climates, however, I doubt that the peat moss would be advisable. The problem there is to get rid of moisture rather than to conserve it. In most gardens subdrainage is the necessity. Drainage may be attained in some cases by raising the bed, in others by tiling from a substratum of gravel. In my dry garden the drainage problem is almost negligible. At some depth the subsoil, a clay shale, is at most times dry enough

to effectually reduce soil moisture by capillary action.

Manifestations of Hardiness

For any cactus grown outdoors, open dry air and full sun provide the best care that can be given. Where needed, a thin surfacing of hard stone chips or gravel will reflect light and heat to the plants.

Finally, what constitutes cactus hardiness? Caeti have a capacity for storing moisture against times of drought. In the growing season temperatures are high and plants become turgid with water, greatly increasing in weight. As winter approaches moisture is given off. Whether the fall be dry or wet the species of the South Dakota plains sense the change of season and begin the process of shriveling. At last the plant cells are dry enough that severe freezing does not rupture them. Borderline kinds may shrivel somewhat but may need snow cover for the severest weather. When so protected they may come through and flower; otherwise they may be injured if not killed.

The only safe ground-level cover is snow, and that preferably light. Prolonged soaking under deep snow has caused injury to some kinds.



An opuntia panorama in the cattle country of southwestern South Dakota.



Buhle

HARDY SUCCULENTS IN A NEW YORK CITY GARDEN

With a guide to the plants shown

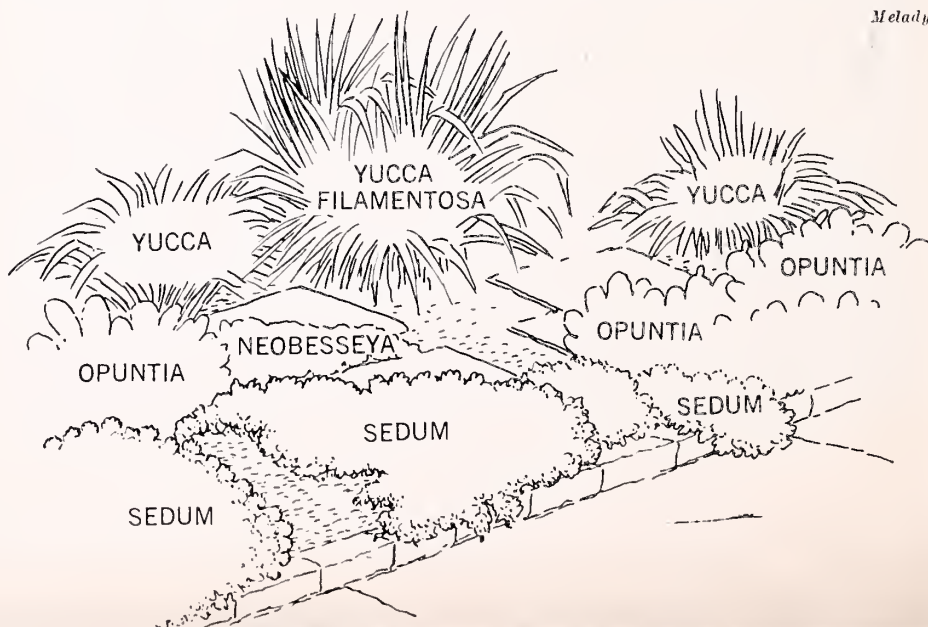
IN a private garden at 359 Eastern Parkway, not far from the Brooklyn Botanic Garden, an imposing collection of hardy cacti is being grown by Joseph Vilchek, President of the New York Cactus and Succulent Society, and Richard Hunt. The success of their planting reveals the possibilities of outdoor cactus gardening in northern regions. Claude A. Barr of Smithwick, South Dakota, can furnish nearly all the species used.

Here are the cacti that they find the hardiest:

Coryphantha vivipara, *Echinocereus viridiflorus*, *Neobesseya missouriensis*, *Opuntia compressa* (the only native cactus growing in this area), also *Opuntia aurea*, *O. fragilis*, *O. humifusa*, *O. nemoralis*, *O. polyacantha*, *O. rhodantha* and *O. rutila*. *Opuntia fuscoatra* and *Sclerocactus whipplei* are also grown, but they are on the borderline of hardiness.

The garden also contains a dozen *Sedum* species, besides the three yucca plants shown in the photograph.

Melady



CULTURE OF SUCCULENTS

Basic principles depend on knowledge of native habitat

Henry Teuscher

FUNDAMENTALS

MOST succulent plants do best with (1) strong light, (2) high daytime temperature, (3) well-regulated watering, (4) porous soil. For species with different requirements, further suggestions are given on the pages that follow.

A basic soil mixture includes sharp sand (one part), clayey topsoil (two parts) and crushed brick or pumice gravel (one-half part). Add ground limestone and bone meal (a handful of each to a bushel of soil mix).

Water thoroughly once a week when plants are growing actively (generally during the bright days of summer). At other times water more lightly. Once a month is ample during their rest period. (Warning: if plants are watered continuously, they will be deprived of their rest period, with subsequent disturbance to their cycle of flowering and growth.)

Most of the tender kinds benefit from outdoor culture in summer.

IT IS evident that the treatment of any kind of plant in cultivation must be governed largely by what is known about the conditions under which it grows in nature. Therefore, to anyone who has read the article on "What is a Succulent?", the basic principles of succulent culture should be no more than a matter of common sense. Only a few adaptations of general plant culture are required to suit the needs of succulents.

The three main factors which control all plant growth are heat, light and moisture *in proper balance*. What the proper balance is depends upon the kind of plant with which we are dealing.

The succulent plants considered here are inhabitants of more or less severely arid regions. This means that they are adapted to receiving plenty of light, are accustomed to high daytime temperatures, and are able to subsist on small supplies of water. The proper balance, so far as they are concerned, is obvious. Nevertheless, the following details may serve to bring this balance into clearer focus for practical application.

When to Apply Water

Water is the most critical of the three main factors. In their native habitats,

these succulents receive rain only during a few months or even a few weeks in the year. The beginning of their growth period is always associated with this rainy spell. The time of year at which such rainfall is due depends on the part of the world or even the specific region that they call home.

Unfortunately, if South African succulents are being grown in the northern hemisphere, it does us little good to know, for instance, at what time of year rain usually falls in the South African semi-deserts. The reason is that while many plants of the southern hemisphere adjust their growth rhythm to the reversed seasons of the North, some refuse to change and some only shift their growth and flowering period by three or four months.

The only safe way to proceed is to watch the plants. When they show signs of getting ready to grow, increase watering. When their growth comes to a stop, water less. They must always have some water, because in nature they depend for many months on the moisture which condenses as dew on and around them, when the air grows cold at night. This dew man cannot easily imitate.

A satisfactory schedule would be to water thoroughly once a week when the

ILLUSTRATED DICTIONARY

of 50 Succulent Plants for Home Culture

plants are growing and at other times more lightly: once in two weeks when the weather is warm, perhaps only once a month when cool.

When growing in a porous medium which drains rapidly and always retains a fair amount of air, succulents will not only tolerate surprisingly high soil humidity but will even thrive on it (see the article on soilless culture by Beate Hahn, page 50). This occurs only, however, when the growing medium is an inert substance such as crushed pumice, the individual particles of which do not stick together.

Caution on Light

In their native habitats, most succulents are sun-lovers. That is, they generally grow only in the full light of the open sky. In cultivation, however, they may be subject to sunburn if they are exposed to strong sunlight after having been without direct sunlight for some time. The critical period is in spring, when certain succulents need to be gradually accustomed to full light, if damage is to be avoided.

Seasonal Temperatures

Since the succulents with which we are dealing come from tropical or subtropical regions, the day temperatures in cultivation should be between 70 and 80 degrees F. for at least six months of the year. The night temperature on the desert, however, often drops below 60 degrees F.: this explains why dew forms. During winter in the tropics there is no frost, but night temperatures may drop below 45 degrees F. Then comes the real rest period for these succulents. The rest period should be provided for them also in cul-

tivation. In fact, when succulents are grown in the home, they should rest in winter when light is always poor, even on the windowsill. They should then be kept cool—at no more than 60 degrees F.—and be watered very little.

Recommended Soil Mixture

Preparation of a suitable soil mixture for the pot-growing of succulents, like their general culture, is a matter of common sense. Plants adapted to living under arid conditions and to the utilization of every bit of moisture that comes their way suffer easily from root-rot, if the soil remains saturated. A fairly rapid interchange between water and air at the roots is essential. This means that the soil has to be porous, so that water penetrates readily and drains away quickly. Sharp sand, therefore, is the first ingredient to acquire. But sand alone drains too fast, besides being infertile. To give the soil more substance, a clayey topsoil is required, and this is the second main ingredient.

A good topsoil—the first 4 or 5 inches from a good field or garden bed—always contains humus. Additional humus therefore is neither required nor desirable.

Sand and clayey soil together, however, are likely to settle down tight, excluding air. To prevent this and to assure free aeration, it is advisable to add one more ingredient. The best material for this purpose is crushed brick (broken pieces of brick, smashed further with a hammer), though crushed pumice stone or pumice gravel may be used instead. The grains of brick or pumice should be from half the size of a pea to slightly larger

(Concluded on page 61)

SUCCULENT PLANTS OUTDOORS



Color photos
chiefly by
George Kalmbacher.

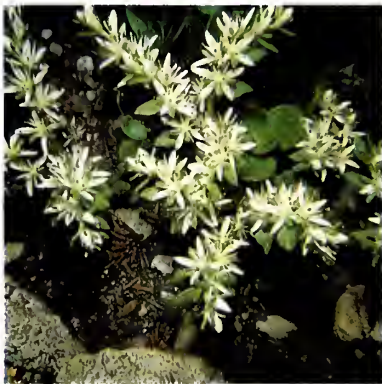
SUCCULENT PLANTS IN FLOWER in the California garden of Mr. and Mrs. Leonard Roberts of Hillsborough. The climate favors some of the most colorful kinds.



COBWEB HOUSELEEK (*Sempervivum arachnoides*). Rock gardens and rock crevices make ideal homes for this hardy succulent from the mountains of southern Europe.



ICE-PLANT (*Cryophytum crystallinum*). Widely used as a house plant, garden annual and ground cover. Native or naturalized in many warm regions of the world.



Sedum ternatum. Moist shade suits this hardy stonecrop. A delicate ground cover, native in temperate parts of eastern North America, and flowering in early summer.



Sedum ellacombianum. Good for sunny spots in the rock garden. A hardy stonecrop, with unbranched stems bearing a mass of bloom in early summer. Japan.

CACTI OF THE AMERICAS



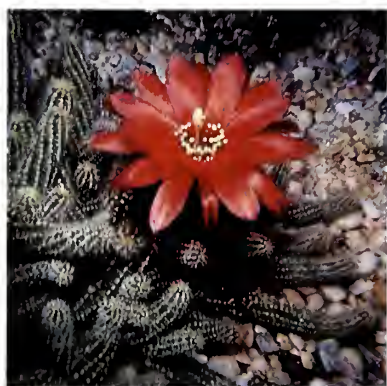
SAGUARO (pronounced "sawaro") (*Carnegiea gigantea*). This dramatic tree cactus of southwestern Arizona may grow to 50 feet. While sometimes transplanted, it does not do well in cultivation. Photo taken in Saguaro National Monument.



Neotocactus leninghausi. Partial shade and very little water best favor the growth and flowering of this spiny cactus from warm regions of southern Brazil.



Mammillaria columbiana. Successful in greenhouse culture if shade is given in hottest part of day. Mammillarias all have nipple-like protuberances. South America.



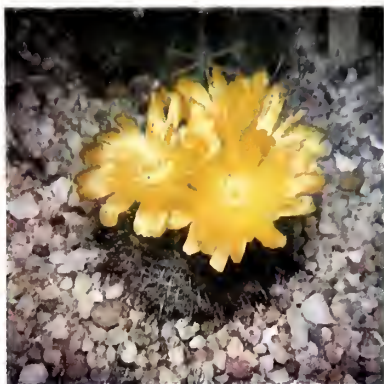
PLANUT CACTUS (*Chamaecereus sylvestri*). Sprawling branches, which break off and root, require space for growth, but only routine care is called for. Argentina.



FIRECRACKER CACTUS (*Cleistocactus baumannii*). Flowers always tubular. For good growth give summer shade and soil high in leaf mold. Uruguay, Paraguay, Argentina.



Hatiora salicornioides. Easily grown in a pot, this spineless cactus lives on tree branches (as an epiphyte) in Brazil. Flowers are small and salmon-colored.



Parodia mutabilis. A small and exceedingly spiny cactus, easily cultivated. Special needs are extra-porous soil, half shade, ample water. From Argentina.



SEA-URCHIN CACTUS (*Astrophytum asterias*). This low spineless cactus from Mexico makes a good slow-growing house plant in full sun. Water ample in summer.



Rhipsalis gibberula. A dangling plant from tropical American forests, best grown in hanging baskets with charcoal in soil. When in growth needs shade and ample moisture.



ORGAN-PIPE CACTUS (*Lemaireocereus marginatus*). Suitable for collections in large greenhouses, or outdoors in tropics. Requires full sun and sandy soil. Mexico.



Pereskia saccharosa. Although a cactus, pereskia has a woody stem and full-sized leaves that persist for an entire season. Needs soil rich in humus. Argentina.

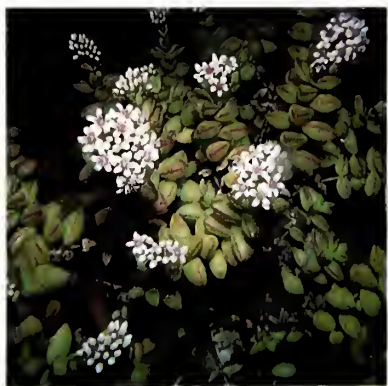
PLANTS FROM SOUTH AFRICA



CARRION-FLOWER (*Piaraulhus pillausi*). A curious milkweed, easily grown if watered sparingly. Small but abundant blooms. Cape Province.



TIGER-JAWS (*Faucaria albidens*). Easily grown, blooming in late summer. Three-sided leaves with hard teeth on the edges characterize the faucarias. Cape Province.



Crassula brevifolia. Average house plant care will bring this shrubby succulent into bloom in a sunny window, if climate hampers outdoor culture. From Cape Province.



BABY-TOES (*Fenestraria aurantiaca*). One of the windowed plants of the South African Karroo. For good growth, sink pots in coarse gravel and water through the gravel.



Euphorbia stellaespina. A vigorous grower, this euphorbia from central Africa resembles a cactus. But there are no areoles, and spines are single.



Pleiospilos simulans. In this stone-plant from the Karroo, a 3½-inch flower emerges from the center of the plant between two closely fitting fleshy leaves. Pebbly soil is best.

CACTI



Gottscho-Schleisner

Unusual cluster of golden barrels (*Echinocactus grusoni*) in Huntington Gardens.



Genereux

Long shaggy hairs on *Opuntia erinacea ursina* give it the name of grizzly-bear cactus.



Kalmbacher

Hatchet-shaped tubercles cover *Pelecyphora aselliformis*, a miniature Mexican species.



Buhle

These small cushions are narcotic mescal buttons or peyote (*Lophophora williamsi*).



Genereux

Columnar form and strips of dense white hair characterize *Cephlocereus palmeri*.



Genereux

The paper-spined opuntia (*Tephrocactus glomeratus*) is an oddity even among cacti.

MORE CACTI



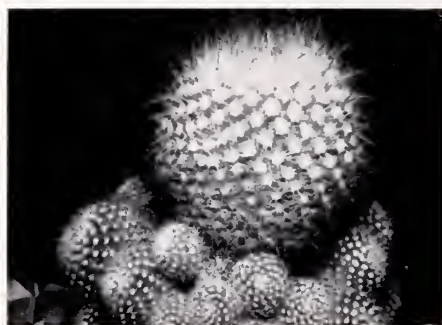
Outak

Chin cacti prove sturdy in cool sunny situations. This is *Gymnocalycium mihanovichi*.



Genereux

Bunny-ears (*Opuntia microdasys*) has no spines but bears many minute barbed bristles.



Kalmbacher

Parodia aureispina, with golden spines, is a miniature barrel cactus, easy to grow.



Outak

Living-rock (*Ariocarpus fissuratus*) is like sculptured stone. Flowers are bright pink.



Buhle

Schlumbergera bridgesi, a Christmas cactus, bears rose-red flowers on its jointed stems.



Buhle

Tall *Cereus peruvianus* is one of several cacti known as night-blooming cereus.

CRASSULAS AND RELATIVES



Buhle

Back row, left to right: *Crassula columnaris*, *C. pyramidalis*, *C. teres*; front row: *C. deceptrix* (with whitish leaves), *C. cornuta*, *C. hemisphaerica*.



University of California
Botanical Garden, Berkeley

Crassula columnaris is started anew from buds after blooming. Flowers are scented.



F. G. Meyer

Only four species of *Greenovia* are known in the world, all native to Canary Islands.



Roche

Crassula obliqua thrives in a sunny window; plant remains compact if watered sparingly.



Taloumis

The burro-tail (*Sedum morganianum*) should be grown in a hanging basket.

VARIED AFRICAN SUCCULENTS



Roche

As a house plant, *Aloë nobilis* requires full sun and little water. It seldom flowers.



M. Skraly

Crimson-streaked blooms of the carrion-flower *Stapelia gigantea* are a foot across.



Schlieben

The many leaves of *Aloë polyphylla* accentuate the spiral pattern of their growth.



Buhle

Unless in flower, the stone-plant *Conophytum* is scarcely recognizable as a living plant.



Roche

Euphorbia grandicornis is said to need more water and richer soil than most succulents.



Colin K. Richards

Cotyledon leucophylla has fleshy, red-edged leaves. Flowers are yellowish and red.

4 FOR HOUSE PLANTS 2 OUTDOOR GIANTS



McFarland

Panda-plant (*Kalanchoe tomentosa*) has white-felted leaves brown dotted at tip.



Roche

Leaf-rosettes of *Echeveria pulvinata* are heavily felted. The flowers are scarlet.



Gantner

The jelly-bean plant (*Sedum pachyphyllum*) has red leaf-tips and bears yellow flowers.

Totem-pole cactus (*Lophocereus schottii monstrosus*), to 20 feet, gives a sculptured effect.

Desert Botanical Garden



Gantner

Aeonium haworthi branches freely, sends out aerial roots. Plant is best kept small.

The saguaro (*Carnegiea gigantea*) bears four-inch scented flowers. (Not for cultivation.)

Campbell



THE "FLOWERING STONES" OF SOUTHERN AFRICA

David S. Hardy



Lithops turbiniformis was the first of the flowering stones of southern Africa to be noted by a European writer. It was not rediscovered at the original site until 1918—more than a century later.

All photographs by H. J. Schlieben, National Herbarium, Pretoria, South Africa

BEFORE dealing with the various groups of plants so often referred to as "flowering stones," it would be well to become acquainted with a little of their history and learn a bit about their habits and their curious structure.

Confined to South and South-West Africa, *Lithops* is perhaps the best known genus of all flowering stones. Thomas Burchell in his famous book, *Travels in the Interior of Southern Africa*, London 1822-24, was the first European to record having seen a lithops. On the 14th of September, 1811, at Zandvlei in the Prieska district of northwest Cape Province, Burchell made note of his interesting discovery as follows: "On picking up from the stony ground what I supposed was a curiously shaped pebble, it proved to be a

plant, and an additional new species to the numerous tribe of the Mesembryanthemum, but in color and appearance bore the closest resemblance to the stones between which it was growing." Because of the fact that Burchell's drawing had been lost or destroyed, it was not until 1918 that the species, now known as *Lithops turbiniformis*, was rediscovered in the same area by Dr. Pole-Evans of Pretoria.

The name *Lithops* is derived from the Greek *lithos*, a stone, and *ops*, a face. The name was given by Dr. N. E. Brown in 1922. A lithops plant consists of two short leaves on a woody underground stem, these leaves together forming an inverted cone, the base of which lies flush with the upper surface of the soil. The top of each of these two leaves is more or

less circular or semilunar in shape and its surface varies from apparently opaque to transparent. As light is an absolute necessity in the life of all green plants, it will be seen that if the top surface were completely opaque, the plants would be unable to absorb light. Lithops developed an interesting solution to this difficulty: all the light required by the plants reaches the chlorophyll-containing cells via window-like structures which make up the surface of the inverted cone.

How and why, in the course of evolution, lithops and other stone plants came to blend so well with their surroundings is something of a mystery, because the plants are rarely eaten by animals.

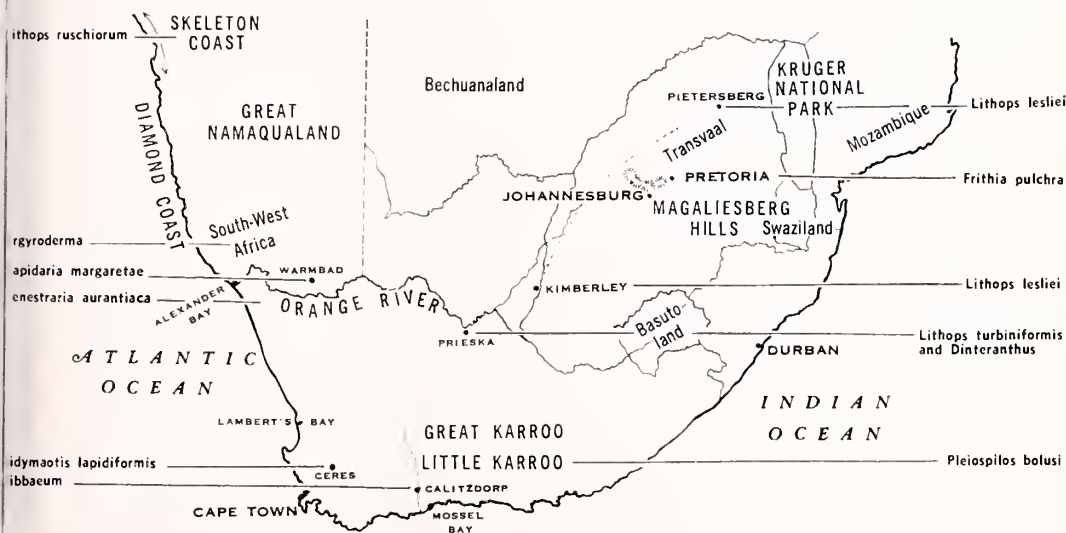
Lithops lesliei, the most widespread species of all, occurs from the Pietersburg district of the Northern Transvaal, where the annual rainfall averages 30 inches, down to the semi-arid areas north and west of Kimberley. The latter region is bitterly cold in winter and the plants at times are subjected to severe frost.

Lithops ruschiorum occurs along the "Skeleton Coast" of South-West Africa, nearly always being found in white quartz

formations. In this region the plants depend on heavy sea mists for much of their moisture, the average annual rainfall being less than half an inch. A number of years often pass without measurable rainfall having been recorded.

One species, *Lithops venteri*, occurs in limestone formations, the gray bodies of the plants blending perfectly with the background. This species seems unaffected by the high lime content in the soil. Yet in cultivation it will thrive in any well drained soil.

Dinteranthus, named in honor of Professor Kurt Dinter, contains six species and appears to be confined to a very small area along the banks of the Orange River. *Dinteranthus vanzijli* and *Dinteranthus pole-evansi*, the most important species, occur only in white quartzite formations, the white bodies of the plants being not only the same color as the surrounding stones but also the same size and shape. As a rule these plants bloom in late afternoon, and it is only when the large golden flowers are fully open that one can readily find them. *Dinteranthus pole-evansi* grows in the same area

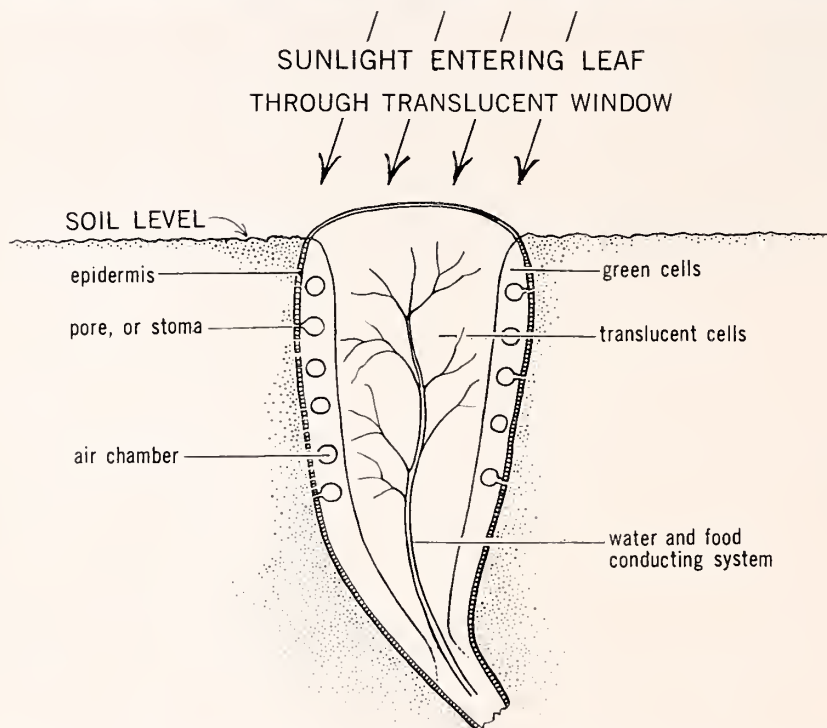


Map of South Africa, showing where some of the "flowering stones" grow in the wild.



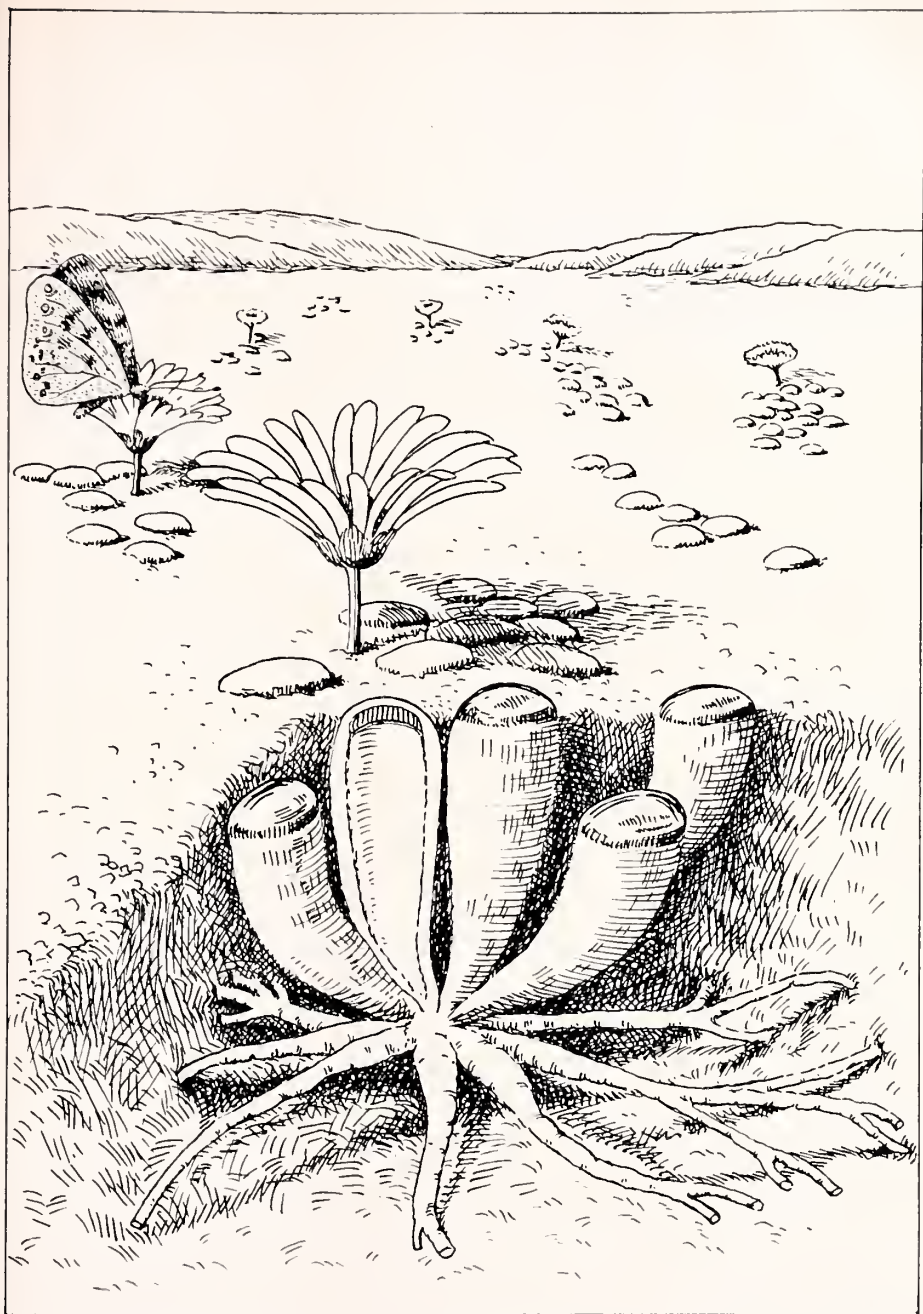
Fenestraria aurantiaca (Also see page 36)

In cultivation and sometimes in nature the green leaves of windowed plants are well above ground. Their translucent windows, or "lenses," at the leaf tips are clearly discernible.



Melady

Diagram of a sectioned leaf of the windowed plant *Fenestraria*, as it would grow submerged in the desert soil. Only the translucent tip of each fleshy leaf is exposed; the balance is below ground. This lens-like tip catches the light and transmits it down through a central core of translucent cells to the adjacent green tissue. From the subterranean darkness of the soil, air (which is essential to the life of the plant) enters air chambers through minute pores (stomata) in the epidermis. These globular chambers occur at intervals in the leaf's external band of green tissue. The translucent core is penetrated by branching strands which carry water and dissolved nutrients throughout the leaf.



Melady

Sketch of windowed plants as they grow in a South African desert, where the exposed tips of the leaves are often difficult to distinguish from small stones. Only when in bloom are the plants noticeable. In the excavated foreground, relatively greatly enlarged, the root system and the submerged finger-like leaves are shown, one leaf in sectional view. (Adapted from the Rudolph Marloth's *Flora of South Africa*, Vol. 1, 1913, color plate facing p. 207)



Species of *Dinteranthus* are confined to a small geographical area in South Africa. Survival of each kind seems to depend on its resemblance to the stones around it. Above is *D. puberulus*.

as *Lithops turbiniformis*, yet each species confines itself to a rock formation capable of hiding the plants from human eyes. All species of *Dinteranthus* are readily injured by surplus moisture.

Lapidaria margaretae, found growing south of Warmbad in South-West Africa, is in appearance the nearest thing one can find to a small weathered pebble. One may search for hours without finding a single plant, yet when the large golden flowers are open the plants can be seen from a long way off. This interesting species is exceptionally easy to succeed with in cultivation.

Many areas in Namaqualand are covered with broken-up quartzite, and it is in such areas that one may encounter members of the genus *Argyroderma*. The name when translated from the Greek means "silver skin." The plants grow under intensely arid conditions and as most of the rain occurs during the winter, finding the plants during the long dry summer is an almost impossible task. Even during the rainy season the swollen, pebble-shaped bodies seem to become part of their background. A curious feature about many of the stone plants is the fact that they appear to have a very limited distribution, all members of the above genus being found within a radius of a hundred miles.

Referred to as the "Aberdeen stone plant" by Dr. Rudolf Marloth, *Pleiospilos bolusi*, because of its strange color and shape, is also often called "liver plant." The species occurs in the Little Karroo, growing among dark, broken-up shale, the keeled succulent leaves of the plants blending perfectly with their surroundings. Another species, *Pleiospilos neli*, although similar in its brown coloration, has ovate bodies. Yet despite their shape the plants remain well hidden.

Along the Diamond Coast, south of Alexander Bay, one may encounter *Fenestraria aurantiaca*. This strange plant grows in deep sand and consists of a number of finger-like bodies, each from one to two inches in length. The ends of the fingers, the large transparent "windows," lie almost flush with the surface of the soil, hence the name *Fenestraria*, for window. A similar plant, *Frithia pulchra*, occurs hundreds of miles away in quartzite gravel along the Magaliesberg hills north and west of Pretoria, Transvaal. This frithia is a smaller plant and the flowers are violet instead of bright yellow as in the fenestraria.

Gibbaeum, the name derived from the



In *Gibbaeum*, one leaf is always larger than its opposite. Shown here is *G. heathi* from the Little Karroo.

How to Grow Stone and Windowed Plants

SOUTH AFRICA'S flowering stones and related succulents will do best in a finely sifted medium that consists of a half-and-half mixture of sand and soil. No fertilizer of any kind should be given, but for plants that come from limestone regions, a little ground limestone should be added.

Skill in growing these plants depends largely on restraint in watering. No water should be supplied during cold or cloudy weather, and none or practically none is required during the winter, even though the skin of the plant may become dried and wrinkled. Watering may be resumed after a period equivalent to a winter season. When growth begins water may be supplied regularly, but the soil should dry out between applications. No water should be allowed to stand on any part of the plant, nor should the soil remain saturated.

To prevent an excess of water from reaching the roots, the plants are best grown in small pots set in larger pots of fine gravel. Or they may be sunk in greenhouse benches filled with gravel. Water, when it is needed, is then applied to the surrounding gravel, rather than to the pots containing the plants.

Where they grow in the wild, these plants are often so covered with sand that only the tips of the fleshy leaves are exposed. Under cultivation, however, the leaves must be allowed to rise above the soil surface. Otherwise the relatively moist air of other than desert regions would cause the plants to rot.

They can be grown in a cool greenhouse with night temperature at 50 degrees F. or lower, as long as frost can be avoided. Sun and fresh air in abundance are essential at all seasons.

Latin word *gibba*, a hump, is a group confined to the white quartzite formations of the Little Karroo, especially around the small towns of Calitzdorp and Van Wyksdorp. *Gibbaeum alba* consists of a number of double-leaved bodies which form a hump or densely packed clump. A curious feature in this group is the fact that one leaf in the pair is always longer than the one below.

In the Ceres Karroo, one encounters a peculiar species known as *Didymaotus lapidiformis*. Although usually dark green in color, this plant cannot be found unless in flower. The golden flowers that appear in early spring are heavily scented, as are most stone flowers.

Why these plants should "try" to conceal themselves for most of the year, yet be so obvious when in flower, is of considerable biological significance. The strongly scented, bright golden flowers attract pollinating insects, thus insuring

seed formation and perpetuation of the species. The flowers of some *Conophytum* species open only during the night.

The seeds of all stone plants are viable for a considerable period, the seed capsules opening only when wetted by rain or heavy dew; when dry they close up again.

It should be borne in mind that in cultivation all stone plants need as much sunlight as possible. Plants cultivated in a moist atmosphere become green and elongated, lacking the beautiful tints encountered in the field.

Unfortunately, as with numerous succulent plants, many of the flowering stones are in danger of becoming extinct and are now rigidly protected by law. Permits to collect such species are granted to bona fide scientific institutes only. Fortunately, many species are cultivated from seed, and thus made available to the public in many countries.

MESEMBRYANTHEMUMS AND SUCH

Showy flowers mark this large, chiefly South African, group of succulents

SUCCULENT fanciers often speak of the "Mesembs" or "Mesems." By this they may mean any of the 2,300 or more species which plant classifiers once included in the genus *Mesembryanthemum*. This large group has now been divided into 122 genera. While a few species are night-bloomers, the majority open their flowers only in the full light of the mid-day sun or shortly after. The open-faced, slender-petaled flowers (by some called "daisy-like") are silky in texture and bright in color—purple, magenta, pink, orange, yellow. Even the white seems brilliant in tone.

Included in this group are the diminutive "flowering stones" of South and South-West Africa. (See article by David Hardy.) While most of the Mesembs are herbaceous perennials, there are a few shrubs and annuals in the group. Best known of the annuals is the ice-plant (*Cryophytum crystallinum*), grown alike

in warm and cold climates both indoors and in gardens, and widely spread through warm regions of the world. It is one of the Mesembs found covering rocky areas along the southern California coast.

Another Mesemb seen in California is the yellow or magenta-flowered Hottentotfig (*Carpobrotus edule*), which covers wide expanses with its bright green fleshy leaves and large vivid blooms. The smaller-flowered *C. chilensis* is native on the coasts of California and Oregon as well as Chile. It is sometimes grown where sand needs to be held in place.

In the southern states the pink-flowered annual *Dorotheanthus gramineus* (*Mesembryanthemum tricolor*) is often found as an escape from gardens.

Aptenia cordifolia, with long trailing branches and small gay-colored flowers, is useful as a carpeting plant.



Buhle

One of the finer-leaved mesembryanthemums, *Lampranthus zeyheri*, commonly planted in warm regions. It grows under the same conditions as the barrel cactus (*Ferocactus acanthoides*) at the right.

SUCCULENTS IN GARDENS



McFarland
Aloë striata from South Africa.



Grossman
Sempervivums may be planted
between flagstones.



Grossman
Container-grown succulents on terrace
(*Sedum spectabile*, *S. ewersi* and *sempervivum*).



Grossman
Sedum album grows in
almost soil-free spots
between stone steps and
←a dry wall.

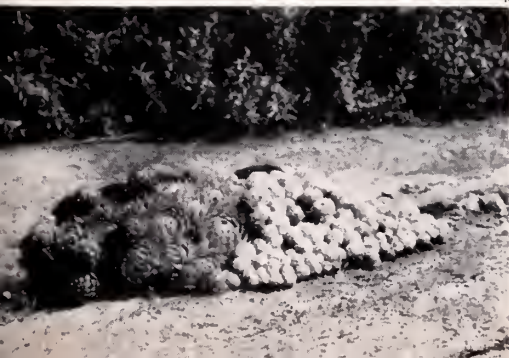


Gantner
Hen-and-chickens (*Sempervivum soboliferum*) takes to the forbidding environment of a rock wall.

Grossman
Planting pocket at
edge of terrace contains
Sedum spectabile; thrives without
special care.→

Cobweb houseleek (*Sempervivum arachnoideum*), at right, like its companion sempervivum, fills narrow rock crevice as it multiplies.

Avery



THE SOILLESS CULTURE OF SUCCULENTS

Beate Hahn

THE principles of hydroponics, or soilless plant culture, are based on the experiments of the famous German chemist von Liebig (1803-73) who showed that inorganic chemical compounds are fully effective in supplying plants with all required nutrients. The first scientists to use water culture—with the roots of the plants suspended in a nutrient solution—were Sachs and Knop (in 1860 and '65), though their aim was merely the scientific study of plant nutrition. The commercial application of this method, which uses gravel beds flooded at regular intervals with nutrient solution, was first carried out in 1936.

The raising of succulent plants in soilless culture became successful only when pumice gravel became commercially available. Pumice is a frothy, very porous and very light glass-like material, which is produced in nature during volcanic eruptions. Pumice gravel is simply volcanic ash. Large deposits of such ash are found in many parts of the world and are mined for various industrial purposes. In the

United States, for instance, they are mined in Kansas, California, New Mexico, Alaska and elsewhere.

For the purpose of hydroponics, pumice gravel (grains about half the size of a pea) has several advantages over sand. Chiefly because of the porosity of the individual particles, it always contains a fair amount of air, no matter how wet it is. Also, it does not become infested with algae.

Before use, pumice gravel has to be washed until all dust is removed, then steam sterilized.

On a sunny window-sill or in a small home greenhouse, succulent plants can be easily raised in pumice gravel with a nutrient solution. All that is needed is a wooden box such as a nursery-size seed-flat, or larger, lined with a plastic sheet to make it water tight.

The box is filled with washed and sterilized pumice gravel, then nutrient solution is poured in until it almost reaches the top. When the medium has become well saturated, which will be after a day or

Willi Wessner



Six-month-old seedlings of peyote (*Lophophora williamsi*) that have been raised in pumice gravel with a nutrient solution. (Shown slightly larger than natural size.)

two, seeds may be sown directly on the pumice. Their germination as well as the subsequent growth of the seedlings will be more rapid than in soil. Cuttings also root readily in pumice gravel.

If succulent plants which have been growing in soil are to be transferred to pumice gravel, their roots must first be carefully and thoroughly washed. It should be pointed out, however, that such washing will not remove any nematodes or fungus infections from pest ridden plants. Only specimens that are known to be healthy should be introduced into the culture medium.

In the nutrient solution, definite elements must be available for the plants. Of first importance are calcium, magnesium, sulfur, nitrogen, phosphorus and potassium in suitable proportions. In addition, such trace elements as boron, zinc and iron are needed in exceedingly small quantities. A simple way for the home gardener to obtain a balanced solution is to use one of the soluble fertilizers, such as Rapid-Gro, Hyponex or Plant-Chem. Manufacturer's directions will supply the needed information on concentrations to be used.

The nutrient solution should be poured into the planting box (to about $\frac{2}{3}$ of its depth) once daily, or twice if the pumice is becoming dry. It is then poured off after a half hour or less. This is done by tipping the box carefully, holding one hand over the surface, so that the liquid drains off at one corner. Renew the nutrient solution about every ten days.

For commercial purposes, seeds are sown and plants are set out in waterproof concrete greenhouse benches, filled with pumice gravel. Every ten days, nutrient solution is slowly pumped into the beds until it almost reaches the surface. It is drained off again after one or two days.

With this procedure, succulent plants may be kept in pumice gravel indefinitely. If potted in the medium, pots should be sunk in the beds of pumice gravel to their rims. Subirrigation with nutrient solu-



Hahn

Mature caeti and other succulent plants growing in pumice gravel in a greenhouse bench.

tion must, of course, be continued on schedule.

The benches are raised to about table height (30 inches), and the depth of the trough is varied according to the purpose: shallow for seed sowing and deeper for larger plants.

When young plants of succulents which have been raised in pumice gravel are potted for sale, a small amount of pumice gravel is mixed with the potting soil.

Succulent plants raised in this manner are free of diseases and pests (unless these have been introduced by plants brought in from soil culture). The natural color of such strong and healthy plants becomes intensified. Flowers appear more brilliant and in some varieties they last longer. Flowering also occurs in greater abundance than in soil.





Cutak

GRAFTED CACTI. Left to right, *Euphorbia lactea cristata* on *E. lactea*; *Lophophora williamsi* on *Cereus validus*; *Rhipsalis cereuscula* on *Selenicereus macdonaldiae*; *Schlumbergera bridgesi* on *Selenicereus pteranthus*.

HOW TO GRAFT CACTI

Sound reasoning guides the grower in this practice

Ladislaus Cutak

GRAFTING is a plantsman's art that is undertaken for practical reasons. It consists of uniting a piece of one plant, called the scion, to a rooted plant, called the stock, in such a way that the two will grow together as one plant.

Among cacti the purpose of grafting may be (1) to save a plant that would otherwise be lost through rot or some other disease, (2) to ensure better growth and (3) to induce more prolific flowering. Cacti should be grafted only for one of these three important reasons, never merely for the purpose of creating monstrosities.

To Save a Plant

When a plant is so far gone that trying to make a cutting from the remaining healthy tissue cannot be expected to save it, the only recourse is to graft a disease-

free piece of it onto a sturdy stock. It is essential to avoid cutting any tissue that the disease has penetrated; the scion must be firm and healthy. The stock must also be in good condition, for it provides both support and nourishment for the new plant that is being created.

For Better Growth and Flowering

Slow-growing species can be brought to maturity more quickly if they are grafted onto a fast-growing stock. By this means they are also made more quickly available for propagation. In some species huskier and more decorative specimens can thus be achieved; in others, a greater profusion of flowers may result.

Crested plants and other abnormal types often grow poorly on their own roots. For this reason they are difficult

to propagate from cuttings. Grafting them onto sturdier stock greatly increases their chance of survival.

The minuscule cacti like *Aztekium*, *Ariocarpus*, *Obregonia*, *Strombocactus* and a few others possess a thickened taproot which requires a rather deep container; however, a container that is deep is also correspondingly wide. Growing these plants under such conditions often causes their demise from the application of too much water. I have found that grafting them will not only save their lives but will make sturdier and more handsome specimens. Plants which are epiphytes in nature, such as *Rhipsalis* and the Christmas cacti *Zygocactus* and *Schlumbergera*, can also be grafted to advantage. In the wild, their shoots droop from the tree branches to which they are attached. Because of this habit, when they are grown as pot-plants they display their flowers most effectively when they are grafted onto a taller stem.

While cacti are grafted more frequently than any other succulent plant, the art can be applied also to some euphorbias. To a lesser degree stapeliads and a few other succulents can be grafted. Acquaintance with the plants and with the methods used are the best guides to the practice.

Although grafting can be performed all year round, it is best accomplished during the height of the growing season,

generally from April to September. It is then that the plants are most vigorous and full of sap, which will ensure perfect union of the parts. When the union is not complete, dry air will cause a thick scab to form over the cut portions and this may eventually cause the scion to be pushed off or broken from the stock.

If directions are followed, a novice can graft cacti without difficulty. The three most commonly used types of graft are the flat graft, the cleft graft, and the side graft. While the thick and globose kinds lend themselves best to the flat graft, cleft grafting is more practical on flat or thin-stemmed plants. Side grafts are used for either kind.

The Flat Graft

The flat graft probably is the easiest to perform. Scion and stock should be of approximately the same thickness at the place where they are to be joined. For the stock, some member of the genus *Cereus* is most commonly used, for it is usually available in collections and it has the quality of fast growth. If species which possess deep ribs must be used (though they are best avoided), further cut the rib sections at a slant from the center of the stem. Species of *Trichocereus*, *Lemaireocereus* and *Harrisia* are better suited, especially for such globose types as *Mammillaria*, *Lophophora*, *Ario-*

Typical grafted plants

Cutak





PERESKIA
on its own roots
(to be used for
understock)



CHRISTMAS CACTUS
(small portion to be
used as scion)



PERESKIA STOCK
showing cleft for
inserting scion
(above)



CHRISTMAS CACTUS
several weeks after
grafting; note growth
of scion

PLANT MATERIAL TO START

Diagrammatic representation of cleft graft between Christmas cactus and pereskia. The understock is simply cut off, as indicated, and slit vertically. The base of the scion is cut on both sides to form a wedge, inserted in slit and held by large thorns or pins.

carpus, *Echinocactus*, *Echinocereus* and *Gymnocalycium*, because their stems offer more surface area for the union.

After selecting the ideal stock for the chosen scion, make a transverse cut with a sharp clean knife on each specimen, lopping off the top portion of the stock and the lower portion of the scion. Then place the scion on the stock, pressing the two flat surfaces firmly together and holding them in place by means of large elastic bands or string or some other convenient method. The cut surfaces must be pressed firmly together until they form a tight-knit union.

The Side Graft

The next easiest graft to try is the side graft. This requires no special operation beyond slicing one side of both the scion and the stock in a slanting cut and fastening the two joints together. Try this first on a *Selenicereus* or other slender-stemmed stock and attach a link of *Chamaecereus* or *Zygocactus* to it. When making a slice remove only about half an inch of the epidermis from both cacti. Simply wrap raffia or cotton string around the attached portions and keep it there until they heal together.

The Cleft Graft

Cleft grafting may prove clumsy at first, but with practice the art will soon

be mastered. The chosen stock should be cut back to a desired height, between 6 and 12 inches, depending upon the type of scion to be used. If the scion has a pendent habit, a higher stock will be appropriate. Make a slit at the top of the stock about an inch deep and if necessary remove a thin slice from it. Next slice both sides of the scion to form a wedge and insert the scion into the split of the stock. Run a spine or two through the united portions to keep them in place and finally wrap some string or raffia around the graft, tight enough to prevent the slit from drawing apart.

The old-fashioned Christmas cactus and similar kinds are favorite subjects for cleft grafting. These are bushy plants of gracefully arching habit, the branches composed of thin leaflike joints. The beautiful flowers appear at the ends of the stems. When grown on their own roots the plants often make a poor display as the flowers hang below the pot, but a grafted specimen becomes a handsome object. This is also true of other epiphytes like *Rhipsalis*, *Werckleocereus*, *Weberocereus*, *Disocactus* and their allies.

The best stock for epiphytes, including *Zygocactus* and *Schlumbergera*, is probably *Pereskia*. There are a number of species, including twining, bushy or tree

(Concluded on page 61)

PROPAGATION OF SUCCULENTS

*Some kinds bloom within a year from seed;
cuttings require special treatment*

Harry Hall

THERE are a number of real advantages to be obtained when succulents are grown from seeds. Some of these are as follows:

Seeds are comparatively cheap and a good number of young plants are soon obtained.

The young stock is usually clean and healthy, or pest-free.

A fair number of kinds will produce flowers in the first year when given the right conditions, examples being found with *Glotiophyllum*, *Titanopsis*, *Faucaria* and *Bergeranthus*.

With certain varieties the only way to be sure of having a specimen that will assume its true form is to raise seedlings. Cuttings or "slips" of these kinds rarely take on the true symmetry for which the particular plant is noted. Furthermore, cuttings of some of the interesting stapeliads, such as *Hoodia* and *Trichocaulon*, are almost impossible to get going, whereas they show remarkably fast growth when raised as seedlings.

Procedures for Seed-sowing

It is most essential that clean soil be chosen, the leaf-mould or compost should be very well decayed, and the sand also clean and somewhat gritty rather than the fine sea-sand which is too often salt-impregnated. Soil derived from the rotted turf from an old lawn is the best possible kind for all basic mixtures for it usually contains adequate plant food for the initial stages of the seedlings.

A suitable mixture for the seeds of the majority of succulents is:

- 2 parts of soil
- 1 part of leaf-mould (or compost, or peat)
- 2 parts of clean, coarse sand.

A small sprinkling of lime is beneficial. No other ingredients are required at this stage.

The whole should be thoroughly mixed, passed through a $\frac{1}{4}$ -inch or $\frac{1}{2}$ -inch sieve to remove the rough material, moistened to the right consistency. (It should slowly fall apart again when a portion is squeezed in the hands.) The rough material from the sieve may be used in the bottom of the containers to act as drainage.

Containers. The depth to which the seeds are covered is governed by their size, and a simple rule is to bury them twice their own diameter. Very fine seeds such as those of *Crassula*, *Cotyledon*, *Lithops* and *Conophytum* should only be given the lightest dusting as a covering. It must be remembered which containers hold the fine seeds since these must be steeped in water to avoid risk of loss by watering overhead. A further advantage gained by steeping is that the whole soil contents are completely moistened. A light layer of fine gravel or very coarse sand particles sprinkled on the surface helps to prevent the seeds from rolling about and also gives the young seedlings a modicum of anchorage and protection until they get firmly established. To reduce the loss of moisture, the containers may be plunged in sand or moss. This also helps considerably to keep the soil temperature from fluctuating between night and day. The containers should be protected from the direct rays of the sun and from the activities of birds, etc., using sheets of paper, twigs, or shaded glass.

Times for Seed Sowing. The seeds may be sown during any of the warmer months, although we know that in nature they germinate with the advent of rains.

Germination. Considerable variation oc-

curs between the various kinds of seeds in the time taken to germinate. The age of the seed has to be considered. The temperature and the time of year also play their part. I have found that all the anacampseros seeds will germinate in less than forty-eight hours. Practically all the stapeliads will appear in two to three days. Most of the vast mesembryanthemum group take a week or so. The harder-shelled seeds of euphorbia take longer and may be spread over several months [or a year], so the pots should never be discarded with undue haste.

Culture Following Germination. Close observation and experience must guide the grower at this stage. Each type behaves in its own peculiar way. With the dwarf species, which are usually, but not always, the slow growers, the seedlings may remain undisturbed for a year, though, of course, gradually getting them accustomed to the light they need, and providing they are not unduly crowded together. Examples: *Conophytum*, *Lithops*, *Dinteranthus* and *Gibbaeum*. The more vigorous types will require spacing out in a few weeks or a month or two, according to progress, and the soil mixture should be a little richer than for the seeds. Plant each seedling about 1 inch apart, using a pointed stick and a little care with the roots.

Vigorous types like *Glottiphyllum* will soon ask for more space and must be given another move, either into boxes or planted out on the rockery. If the seedlings of the popular and very showy "Mesems" are spaced about 2 inches apart in the boxes they can be transplanted into their permanent quarters with a good portion of soil around their roots. Whether transferred from pots into boxes, or out into their flowering positions, they must be well watered afterwards to settle them in and give them a good start.

Crassula falcata requires no soil covering after sowing, though the boxes must be shaded from the sun and kept steadily moist. Germination is usually good but the seedlings are rather slow for the first year. This species likes a rich soil with a

fair proportion of humus, and also some watering in summer if the weather is dry.

The slower-growing types such as *Argyroderna*, *Lithops*, *Conophytum* and *Dinteranthus* must be allowed to dry out slightly between waterings, especially when they begin to acquire their adult form. If moss forms on the surface of the soil in the pans or pots it is an indication that they are kept too wet. It is also a danger sign and can be responsible for the "damping off" which will destroy valuable plants very swiftly. This may be remedied by drying out the soil and giving more airy conditions. These slow-growing species dislike hot, humid conditions, especially under glass in this country, and the more fresh air they can get the healthier they will become, always bearing in mind that the soil and the roots are not allowed to get overheated by the sun in summer.

Propagation by Cuttings

Succulents are among the easiest plants to be propagated by cuttings. The best time for this practice is during the warmer months, a certain degree of warmth being one of the factors which assist root formation.

With the more fleshy succulents such as the aloes and euphorbias, it is very important to allow the cut surfaces to dry off thoroughly before planting. Choose healthy young branches. Whenever possible, make the cut where there is a natural joint, especially with euphorbias. For one thing, the cut area is smaller and the formation of roots takes place more easily.

The more valuable species are best rooted in pots or boxes in a frame, using a very sandy soil and protecting the cuttings from strong light. While many kinds can be struck directly in their permanent site with no more care than a support until their own roots supply sufficient anchorage, examples being *Aloë arborescens*, *Cotyledon orbiculata* and *Crassula argentea*, there are many others which require more time and care. The majority of the fleshy euphorbias should be kept quite dry until roots have com-

(Concluded on page 68)

INSECTS AND NEMATODES

If plants are watched, these pests give little trouble

S. D. Van Gundy and R. N. Jefferson

When Pests Appear . . .

Above ground, on the plant:

Use a recommended spray or dust (see Control Measures, page 59), taking care to follow precisely all directions on the container.

Do not treat plants when they are in the sun.

Below ground, on roots and in the soil:

Nematodes give plants a stunted, pallid look. Remove all roots and reroot the top part in sterilized soil.

Mealybugs on roots cause plants to shrivel. Soak soil in a dilute solution of lindane.

THOUGH a number of insect and nematode pests attack cacti and other succulent plants, the amateur grower, with a limited number of plants in a small greenhouse, or in his home, need only be concerned with a few common ones which are easily recognized and can be controlled by rather simple methods.

Beginners seldom realize the importance of early control of diseases and pests. If an outbreak of pests goes unchecked, the health of the plants may be seriously impaired. Even a well grown collection can be attacked by pests unless careful watch is kept and problems are dealt with as they appear. Sometimes it is best to destroy a badly infested plant rather than run the risk of the infestation spreading to the whole collection. The close examination and isolation of newly acquired plants and the use of appropriate treatments will do much to prevent serious outbreaks.

Although the common insect and nematode pests are easily recognized, they are usually small in size and may be hidden in the soil or in leaf joints and flower buds until they have multiplied to such numbers that their effects on the plants are obvious. These pests derive their

food from the plant, and this feeding reduces the plant's vitality, discolors the leaves, and distorts and deforms new growth and flowers. Insects and nematodes in the soil may actually keep the plant from growing or flowering. Therefore it is necessary to watch closely any plant that is not growing properly. If no pests can be detected on the plant body, uproot the plant and see if insects or nematodes are feeding on the roots.

Insects

The insects most frequently encountered on or around succulent plants are ants, mealybugs, aphids, scale, and spider mites. The ants are not really pests of the succulents—only agents for the spread of other insects. They carry mealybugs and aphids from plant to plant, establishing and tending colonies for the production of honeydew, an exudation of these insects. Therefore, control of ants in the garden and greenhouse will reduce the invasion and spread prevalence of other insect pests.

Aphids are probably the most common of the insects that attack succulents, usually being more prevalent in the spring



Aphids feeding on the flowering stalk of an echeveria

when they move indoors from numerous outdoor infestations. They are small, green to black, soft-bodied creatures which usually attack the tender growing shoots and flowers of the plant. They are particularly bad on the shoots and flowers of *Echeveria* and *Cotyledon*, and on the flowers of *Ephiphyllum*. They cause young growth to become distorted and covered with honeydew.

Mealybugs are about the size of a grain of wheat and covered with a whitish or grayish powder wax. They are found on the roots and/or stems of nearly all kinds of succulents, as well as on numerous other plants; they are very prolific. Their presence below ground is easily recognized by the whitish waxy materials secreted on the roots and in the soil, and also by their honeydew, which is eagerly sought by ants. A severe infestation will cause plants to dry and shrivel.*

The **cactus scale** (*Diaspis echinocacti*)

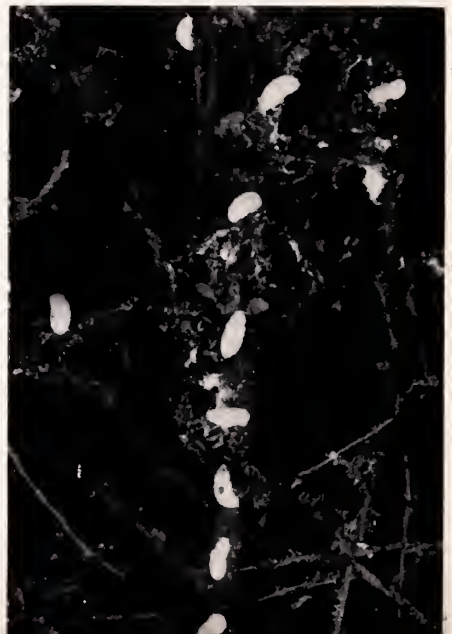
*Control of root mealybugs (*Rhizococcus falcifer*) is difficult. Soaking the soil twice, two weeks apart, with a dilute solution of lindane has been suggested. Use 1 tablespoon of wettable powder in 1 gallon of water. (See Pirone, Dodge & Rickett, *Diseases and Pests of Ornamental Plants*.)—Ed.

frequently infests *Opuntia*, *Cereus* and *Ephiphyllum* outside in the garden, as well in the greenhouse or house. The female insect is housed under a thin, circular, light-gray, protective shell-like covering which makes eradication very difficult with most sprays. This scale insect is so prolific that if left unchecked it will form a crust over the surface of the plant. Heavy infestations will soon sap the plant of its vigor, and it will dry and die if left unattended.

Another scale insect found on cacti is the **woolly cactus scale** (*Eriococcus coccineus*). This is often confused with mealybugs since in the active stages it is covered with a white powdery wax. The full-grown insect is enclosed in a white, woolly sac. Because of its appearance and tendency to congregate on the spines, it sometimes is mistakenly called the spine mealybug.

Red spider mites are a problem indoors, particularly in winter when plants are more or less dormant. They are yellowish to reddish and, being very small, are best seen under a magnifying glass. They cause small yellowish spots on the stems and leaves. These spots increase in number until a general gray or silvery effect is produced. Generally a thin web is formed to protect the mites. The rat-tail

Root mealybugs and waxy exudate on the roots of aconium



and peanut cacti are especially susceptible to attack.

Nematodes

The most important group of nematodes attacking succulents are the **root-knot nematodes** (*Meloidogyne*). They are microscopic roundworms which enter the roots of many species of plants and cause irregular swellings or galls. These characteristic knots facilitate the ready identification of this nematode pest. On young roots, the galls appear as beads on a string. Round to elongated swellings up to one inch in diameter may develop in older roots. Heavy infestations are usually accompanied by extensive rotting of the root system, and the plants may be killed. Most species of cacti and other succulents are susceptible to attack. Affected plants usually appear stunted and pale in color. Nematodes are a serious pest of nursery-grown plants and are present in many soils. Once the roots become infested, it is necessary to cut off all the roots and reroot the top part in sterilized soil.

Control Measures

Aerial insects and mites. A number of insecticides are available to the amateur

An opuntia stem covered with cactus scale



Spindle-shaped galls and knots of the root-knot nematode on the roots of a crassula

for the control of insect pests and mites. Pyrethrum-rotenone and Black Leaf 40 (nicotine sulfate sprays) are effective against aphids and safe on most plants, Malathion sprays will control aphids, mealybugs and scale insects. Kelthane is effective against spider mites. Both of these materials may cause burning on some varieties. Chlordane dusts or sprays can be used for ant control, provided they are not put directly on the plants. Carefully follow the directions on the containers for specific pests and never spray plants when exposed to the sun.

For those who have a small collection and plenty of time to watch their plants closely, the use of denatured or wood alcohol for insect control is good. Individual insects can be killed by touching them with a brush dipped in alcohol. Dipping plants and roots, or spraying lightly with alcohol may be done in moderation.

Soil-borne insects and nematodes. Sterilization of the potting soil with a heat treatment of from 180 to 212 degrees F. for thirty minutes will kill most fungi, insects, and nematodes.

DISEASE PREVENTION MEASURES

Three-part program will help in keeping plants healthy

Richard D. Durbin

WITH present-day technology and knowledge, many plant diseases are no longer a necessary evil, but they are still a needless waste. Taking steps to prevent the introduction of disease-carrying organisms, or pathogens, is preferable to trying to eliminate already established ones. Since many diseases cannot be eliminated from an outdoor planting or a greenhouse without destroying the affected plants, forestalling an infection is especially important when plants are rare or of high aesthetic value. Therefore the emphasis in plant disease control should be on prevention rather than on therapy.

To be successful, a preventive program involves three constituents: disease-free soil, disease-free plants, and cultural practices designed to keep soils and plants free of harmful organisms. Each of these three parts, like each leg of a three-legged stool, is of equal importance.

Giving Attention to Soil

It is not safe to assume that natural soils are free of pathogens. Indeed, disease-causing fungi and bacteria, as well as nematodes, are likely to be present.

Plants obtained directly from nature or from commercial growers who fail to treat their soil may therefore be infected. Once a soil-borne pathogen has become established, there is no treatment that will eliminate it from the soil without destroying the plants already growing there. Soils free from disease organisms can be obtained only through fumigation.

Obtaining Disease-free Plants

Pathogen-free plants are most easily grown by starting them either from seed or from cuttings taken as far from the ground as possible on the mother plant. Once disease-causing organisms have been thwarted or eliminated, cactus plants should remain healthy indefinitely unless they are recontaminated.

How Diseases Are Spread

Disease organisms are spread from plant to plant by several means: directly through the air or on wind-borne soil particles, in splashing water drops, by insects, or by infested tools (especially pruning equipment), clothing or hands. If a potential pathogen touches a plant,

Soil Fumigation

CHEMICAL treatments are easily handled by the home grower, for they can be done on a small scale, and require no large initial capital outlay. The most effective fumigants are those which act in soil in a gaseous state. Consequently the treatment must be in a confined space, such as in garbage pails with tight-fitting covers, under plastic tarps, or by watering the top of the treated soil thoroughly to a depth of 6 to 12 inches, to form a gas seal.

Some commercially used chemicals, such as methyl bromide, are sold in the form of pressurized liquids in one-pound cans, the amount required to treat 25 cubic feet of space. Other chemicals (Vapam, for example) come as water-soluble liquids or solids and are watered onto the soil. These are especially effective on the lighter types of soils. Directions and warnings on cans should be heeded.

After any treatment the soil should be kept confined for several days. Then it should be given an aeration period of one to two weeks to facilitate escape of gases, for these are toxic to green plants as well as to the microorganisms they are expected to kill. They are even toxic to the seeds of green plants—which means that weed seeds as well as pathogens and insects are largely eliminated.

it may enter by one of several routes: through natural openings such as stomata, directly through the epidermis, or through wounds. Aerial pathogens also require the presence of free water on the plant's surface for their penetration. Therefore, overhead watering, splashing while watering, laying the hose nozzle on the ground, and unnecessary wounding of plants should be all avoided. Any plant suspected of being diseased should be well isolated from other plants and destroyed if found to be infected lest it serve as a source for further spread of the pathogen. Disease can be generally detected by the softening or spotting of a portion of the tissue. Identification of the disease, however, is a job for a plant pathologist. Inquire of your State Agricultural College or Experiment Station.

Correct cultural practices should do away with the possibility of reinfection of clean plants. Details are presented

in Kenneth F. Baker's publication, listed in the references below. But if disease does attack the aerial portion of a plant, it can usually be eradicated by employing a chemical spray program. Equipment and procedures for doing this are discussed in the three remaining references.

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(Continued from page 32)

Dust should be sifted out. Besides aiding aeration, these porous chips will hold reserves of small amounts of moisture without clumping the soil.

Effective proportions are: 2 parts of clayey topsoil or sodsoil, 1 part of sharp sand, 1/2 part of crushed brick. To each bushel of this mixture may be added a handful of bone meal and a handful of ground agricultural limestone. A pinch of fritted (or chelated) trace elements is a desirable addition to each pot.

Repotting and Feeding

How long should a plant remain in a pot of this soil? In nature, the dependence on nightly dew during a large part of the year causes many succulents to develop a wide-spreading root-system which quite often is rather shallow. The potting soil for succulents should always be rather lean, and when those with spreading root-systems are confined in pots, they quickly exhaust the available nutrients. Therefore, they should be transplanted

into fresh soil every second year, though it may not be necessary to increase the size of the pot. A very mild fertilizer solution may be applied to succulents, but only at the beginning of their growth period. It is likely to be harmful at other times.

(Continued from page 54)

types, and all have fairly sturdy stems which will prove far superior as stocks to anything else in the *Caetus* Family. Sometimes *Hylocereus* stock is used but it is not as satisfactory as *Pereskia*.

After the grower is acquainted with the caeti, studies their habits, their needs and wants, he will soon learn which stocks are best for particular scions.

After Grafting

When all grafting operations are completed, place the grafted specimens in a warm and shaded room or part of the greenhouse. Be careful in watering so that no moisture gets on the grafted portion, and inspect all grafts periodically to see how they are faring.

OUTSTANDING COLLECTIONS OF SUCCULENTS



William Hertrich

Cacti in the Huntington Gardens, San Marino, California. Left foreground, *Cereus peruvianus monstrosus*; large plant in center, *Cereus xanthocarpus*; right foreground, *Trichocereus spachianus*.

United States

ARIZONA: Boyce Thompson Southwestern Arboretum, Superior

Cacti: 75 genera; 300 species

Other succulents: 50 genera; 250 species

Desert Botanical Garden, Phoenix

Cacti: 118 genera; 1,360 species

Other succulents: 42 genera; 930 species

Desert trees and shrubs: 120 genera; 930 species

CALIFORNIA: Huntington Gardens, San Marino

Cacti and other succulents: 215 genera; 1,100 species

"Lotusland," Santa Barbara. Estate of Mme. Ganna Walska. Said to comprise the largest private collection of succulents in the United States. Open by appointment.

Rancho-Santa Ana Botanic Garden, Claremont

Cacti: 5 genera; 32 species; 15 genera (all California natives)

Other succulents: 4 genera; 22 species; 4 varieties (all California natives)

University of California Botanical Garden, Berkeley

Cacti and other succulents: 366 genera; 4,000 species

HAWAII: Pa'u-a-Laka Gardens, Koloa, Poipu, Kauai. Private garden of Hector and Alexandra Moir, open to the public for a small fee.

Cacti: 22 genera; 86 species

Other succulents: 28 genera; 218 species

MICHIGAN: University of Michigan, Ann Arbor

Cacti: 68 genera; 319 species
Other succulents: 88 genera; 376 species
 MISSOURI: Missouri Botanical Garden, St. Louis
Cacti and other succulents: 200 genera; 1,200 species

NEW YORK: Brooklyn Botanic Garden, 1000 Washington Avenue, Brooklyn

Cacti: 109 genera; 483 species

Other succulents: 96 genera; 568 species

New York Botanical Garden, Bronx Park

Cacti: 90 genera; 650 species and varieties

Other succulents: 105 genera; 950 species and varieties

Canada

Montreal Botanical Garden, Montreal, P.Q.

Cacti: 113 genera; 647 species

Other succulents: 216 genera; 1,268 species

Europe

ENGLAND: Kew Gardens (Royal Botanic Gardens), near London

FRANCE: Les Cèdres, Cap Ferrat. Private garden of J. Marnier-Lapostolle, open for educational and research purposes. Said to contain one of the largest assortments of succulents in Europe.

Thirteen-inch white to bronze flower of *Mediocalyx megalanthus*. Native in Peru. Dr. Hutchison reports that this flower has not been previously pictured. Midnight photo made at University of California Botanical Garden, Berkeley.



Paul C. Hutchison



Scene in the succulent garden of Mr. & Mrs. Hector Moir on the Hawaiian island of Kauai.

GERMANY: Botanical Garden, Nymphenburg, Munich

Botanical Garden of Heidelberg University, Heidelberg

Botanical Garden of Kiel University, Kiel
 Palm Garden, Frankfurt

ITALY: La Mortola, Villa Hanbury, near Ventimiglia

MONACO: Le Jardin Exotique (Exotic Garden). Contains about 6,000 species, mostly of succulent plants.

SPAIN: Marimurtra, Blanes, 50 miles north of Barcelona. Private botanic garden, formerly the estate of Carlos Faust.

Pinya de Rosa, Blanes. Private garden of Fernando Rivière-Caralt. Contains more than 380 species of cacti besides many other succulent plants.

SWITZERLAND: Municipal Succulent Col-



F. G. Meyer

Tall specimens of *Cereus* in the cliffside
Exotic Garden, Monaco.

lection (Städtische Succulenten Sammlung),
Zurich.

Cacti: 177 genera; 1,700 species

Other succulents: 153 genera; 1,600 species

Cactus seed collection: 2,400 species

Australia

Cactus Garden of the Botanic Garden, Bris-
bane

Israel

"Gan Yanoif," Haifa (at the foot of Mt.
Carmel)

South Africa

Botanical Garden, Brummeria, Pretoria
Christian's Garden, Salisbury, Southern Rho-
desia

Karoo Garden, Worcester, Cape Province
Kirstenbosch National Botanic Gardens,
Newlands, Cape Province

Munda Wanga Botanic Garden, Chilanga,
near Lusaka, Northern Rhodesia
University of Stellenbosch Botanic Gardens

DEALERS IN SUCCULENT PLANTS

United States

Claude A. Barr, Smithwick, South Dakota
(hardy cacti)

Bealum Gardens, 2686 East Paloma Street,
Pasadena 8, California (epiphyllums and
haworthias)

Davis Cactus Garden, 1522 Jefferson Street,
Kerrville, Texas

A. Hugh Dial, 7685 Deer Trail, Yucca Val-
ley, California

El Paso Cactus Gardens, Anthony, New
Mexico-Texas

Gates Cactus, Inc., Corona, California

Helen's Cactus, 2205 Mirasol, Brownsville,
Texas

Hummel's Exotic Gardens, 3926 Park Drive,
Carlsbad, California (wholesale)

International Succulent Institute, 921 Mur-
chison Drive, Millbrae, California

Johnson Cactus Gardens, Paramount, Cali-
fornia

Ethel Karr, Kaktus, Route 1, Box 87, Canon
City, Colorado (hardy cacti)

MacPherson Gardens, 2920 Starr Avenue,
Oregon 16, Ohio (sempervivums)

Merry Gardens, Camden, Maine

Rocking Horse Cactus Gardens, 2415 West
Glenrosa, Phoenix 15, Arizona

Julius Roehrs, East Rutherford, New Jersey
Rosso's Cacti Nursery, 25399 Highway 99,
Loma Linda, California

Harry E. Saier, Dimondale, Michigan (seeds)

Southwest Cactus Company, Homer A. Jones,
Box 851, Alpine, Texas

Tropical Paradise Greenhouse, 8825 West
79th Street, Overland Park, Kansas

Outside United States

England

T. N. Blackburn, Woodplumpton, near Pres-
ton, England

J. W. Churchman and Sons, Ltd., 151 Lee-
ming Lane North, Mansfield Woodhouse,
Nottinghamshire, England

Ernest Hepworth, 133 Ambleside Avenue,
Telscombe Cliffs, Sussex, England

Holly Gate Nursery, Spear Hill, Ashington,
Sussex, England (epiphytic cacti and epi-
phyllum hybrids)

Upland Nurseries, Blackhorse Lane, Down-
end, Bristol, England

World Garden, Bridgnorth, Shropshire,
England

Wyck Hill Nurseries, Stow-on-the-Wold,
Gloucestershire, England

Germany

Albert Schenkel, Hamburg, Blankensee, Germany (seeds)

A. Stirnadel, Zweibrücken-Oberauerbach/Pfalz, Germany

Karlheinz Uhlig, 7053 Rommelshausen bei Stuttgart, Lilienstrasse 5, Germany

H. Winter, Frankfurt am Main-Feehenheim, Germany (seeds)

Japan

Kyorakuen Nursery, Fujisawa, Kanagawa, Japan

Mexico

La Quinta-F. Schmoll, Cadereyta des Montes, Qro., Mexico

New Zealand

A. Bruce Cutter, Springbank Road, Kerikeri Central, Bay of Islands, New Zealand

South Africa

Magaliesberg Nurseries, P.O. Box 1193, Pretoria, South Africa

Mr. Malherbe, Klaas Vogts, near Robertson, Cape, South Africa

Heunie Naude's Aloe Nursery, 100 Louis Trichard Road, Pretoria North, Pretoria, South Africa

Sheilam Nurseries, P.O. Box 157, Robertson, Cape, South Africa

Succulenta Nurseries, Suvla, Military Road, Hout Bay, Cape, South Africa

CACTUS AND SUCCULENT SOCIETIES

JOINING an organization devoted to the study and culture of a particular group of plants can be a stimulating experience for the gardener with a hobby. Often there are conveniently located branches, or chapters, where one can attend meetings and exchange plant material as well as experiences. Two leading societies concerned with succulent plants are:

Cactus and Succulent Society of America. Founded 1929. 2400 members. *Cactus and Succulent Journal* published six times a year. Scott Haselton, Editor, 132 West Union Street, Pasadena, California.

Cactus and Succulent Society of Great Britain (affiliated with the Royal Horticultural Society). 1931. Holds exhibitions and monthly meetings. Publishes *The Cactus Journal*, quarterly. E. Shurly, Editor. For information write to K. H. Walden, F.R.H.S., Hon. Secretary, 152, Ardgowan Road, Catford, London, S.E. 6, England.



Elizabeth Scholtz

The dominant feature of this planting of succulents is *Aloe marlothii*. Christian's Garden, near Salisbury, Southern Rhodesia.



Buhle

The little care required by "foolproof" succulents in this well-lighted and well-ventilated miniature desert garden (3 x 5 feet) makes the plants "neglector's items."

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- and SLOANE. *The Stapeliaceae of Southern Africa*.* 3 vols., 1200 pages. 1937.

*Abbey Garden Press, 132 West Union Street, Pasadena, California. Many other titles, published elsewhere, are also available from this address.

menced; in fact, watering may kill them in a matter of days whereas they will remain healthy and apparently unchanged for many months if kept perfectly dry. Succulents are much more easily killed by water than by drought, in cultivation, at any rate. Since a cutting of this type has no roots for perhaps months, but has enough sustenance to last a very long time, water could not be utilized if it were given it. Some species are best rooted by tying the cutting to a stake so that the base is merely touching the surface of the soil. I have often kept cuttings of the larger, tree types on a dry shelf until roots have commenced to show, though it may take three or four months in the process. It is better to be sure than sorry, especially with euphorbias.

A popular substance for rooting most

cuttings of this nature is vermiculite, which is quite inert but retains a little moisture for a long time, has plenty of air space in it, and allows the cuttings to be examined from time to time without damage to any of the young roots which may have formed.

Leaf Cuttings. A surprisingly large number of succulents can be propagated by their leaves, or merely portions of leaves. The gasterias and many haworthias, also crassulas and kalanchoës, may all be propagated in this manner. In all cases, whether entire leaves or merely portions of leaves are used, they should be dried off for a few days before laying them on a light sandy soil in boxes or in a frame. A light shade from the strong sun is essential. No advantage is gained by burying the bases of the cuttings. It is not unusual to obtain a dozen or more healthy young plants from a single leaf.



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VOL. 19

NO. 4



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and the Editorial Committee of the Brooklyn Botanic Garden

FRANCES A. DÄMM, *Secretary of Publications*

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The Year-end, 1963-64

This is the 19th consecutive year that the Botanic Garden's Editorial Committee has searched journals and bulletins for the past year's outstanding articles on gardening and horticulture. It is not a simple task. Sometimes it seems as if "the best" are about one subject. To condense and publish only these would fail to bring readers a year-end digest. Perhaps we have missed the best in garden prose, but we have sought the worthiest—in terms of ideas, usefulness, background, and general appreciation of the art and science of gardening and horticulture. This is our way of honoring the authors, and we want to thank them—as well as the editors and publishers of the original articles for their always warm cooperation in making possible this digest of "articles of the year."

The organic gardening controversy pops up every season, but generally without new evidence; this year the data will be of wide interest (page 4). "Pre-fabricated" lawns, a relatively new and almost completely mechanized industry, brings hope, at last, to those with difficult grass plots. Moreover, it offers good prospects in many localities for establishing a new business enterprise (page 11). Then there is the matter of land preservation and the legal hurdles that conservationists might well consider as they pursue their objectives (page 19). And for those who like wild land but wish to establish at least a semblance of control, the piece by Messrs. Niering and Goodwin will open a world of suggestions and practical procedures (page 26). The pages that follow offer a broad spectrum of ideas that characterize 1963 writings. Meritorious contributions should "get around," and an important Brooklyn Botanic Garden objective is to help as much as possible in this all-important field of communication.

Here is a little story that may amuse readers, but it has a point for thought: Last autumn a member of our staff gave a lecture on "Conservation: Word or Deed?" He was invited to give the same talk before another group—then came this somewhat frantic appeal from the program chairman . . . "I hope it isn't too much of an imposition to ask you to tackle the job of creating a new word that will replace that alarming c-o-n-s-e-r-v-a-t-i-o-n in your title. We want to attract people for the lecture . . . I would greatly appreciate hearing from you as soon as humanly possible." Are others having problems when speakers hold forth on conservation? The subject is so vital that utterance of the word alone should do more than bring a tired sigh when a lecture on the subject is announced. Botanic Garden Trustee and talented author, Rutherford Platt, feels keenly about it, and (he writes) . . . "The word conservation is overworked, boring, static. I did not use it, not with a single mention, in my book WILDERNESS . . . yet that entire book was on conservation."

Special subject Handbooks scheduled for publication in 1964 are FLOWERING SHRUBS, GARDEN CONSTRUCTION, and the USE OF NATURAL PLANT DYES (all over the world). We hope you will enjoy them.

Sincerely,

Director

P.S. The Editorial Committee occasionally catches an error in the name of a plant—usually in time to correct it in proof. This time the error found its way into print, SO—in your Handbook on Succulent Plants, page 50, please change the name of the plant in the picture caption to *Euphorbia obesa*.

SEEDS. A year or so ago, PLANTS & GARDENS readers were invited to ask for seeds of flowering dogwood (*Cornus florida*), together with directions for growing them. We repeat the offer now, on a first-come first-served basis. Please send a stamped, self-addressed envelope.

DOES ORGANIC MATTER REALLY MATTER?

*Crop yield and quality may be as high on fertilized subsoil
as with humus-rich topsoil*

Ralph Reynolds

IN our forefathers' day, farm production was tied to humus, a thin skin of plant residue on forest and prairie soils. As this declined, yields declined. As a result, organic matter—through the centuries—has loomed as almost magical in its properties. With the coming of fertilizers yields soared beyond the old humus barriers, but "black dirt" is still sacred in the eyes of many. While humus makes soil look better, feel better, and handle better, there's evidence that some field and vegetable crops don't care much one way or the other.

THE great black topsoils of this continent were thousands of years in the making, and any loss of their organic matter has weighed heavily on the conscience of the country. By the twentieth century, statesman, politician, farmer and scientist were agreed that soil humus—America's fertility mine—was disappearing at the rate of 1 per cent or more per year.

Such decline has generally continued, and release of nutrients from the decay is still an important source of plant food. However, in some areas, farmers are substituting fertilizer for humus, making yields virtually independent of organic-matter level.

Arizona's high-yielding and high-priced land averages one-tenth of 1 per cent organic matter, only one-twentieth as much as in most Corn Belt soils. California's rich agriculture is also based on applied fertility.

Irrigation farmers have prospered without black soil, but what might be the con-

sequence of humus depletion elsewhere? With the trend toward continuous row crops, and consequent decline in humus, this has become a question of enormous importance.

In the spring of 1957, scientists O. P. Engelstad and W. D. Shrader laid out a remarkable experiment near Clarinda, Iowa. Some plots were scraped bare of topsoil, others left in normal condition. With adequate fertilizer, subsoil yielded as high as normal soil (1958 results in chart). Cost of extra nitrogen: \$10 per acre.

Despite a drastic cut in humus, this soil produced well. But what about long term effects? From neighboring Illinois comes a hint. In 1937, researchers shaved 10 inches from a deep soil near Dixon, exposing the subsurface. They cut 20 inches—to the subsoil—on a second plot. These, along with a surface plot, were lightly fertilized (150 pounds 10-20-20) and cropped with corn, oats, and alfalfa until 1959. For the first 3 years, topsoil aver-

Reprinted, with permission, from *The Furrow*, the John Deere magazine, Moline, Illinois, May 1963

aged 11 bushels more corn per acre (92 vs. 81). In 5 years, yields were equal. Average for 1955-58: topsoil—114 bushels, subsurface—129, subsoil—118.

All such tests show why many talented farm scientists soft-pedal the role of humus on modern farms. Especially there's a feeling that organic matter scarcely lives up to the sacred status it still widely enjoys.

"Maybe we're just fighting dead snakes," says USDA microbiologist, T. M. McCalla. "There are problems with organic matter and a different set of problems without it." In a project with wide implications, McCalla and fellow scientist W. D. Guenzi, are studying the role of phytotoxins in stubble-mulch farming. These are growth-retarding substances, released from fresh organic matter. Says McCalla, "Under high yields you're bound to have residue return and you have to manage this residue. Instead of worrying too much about organic matter, just for the sake of organic matter alone, let's find out what the plant needs and put that on."

Foremost among the many benefits claimed for organic matter is fertility. The trouble is you can't have this cake and eat it, too—fertility is released only as organic matter declines in the soil. Under row crops, a fertilized "mineral" soil will soon reach the same fertility level as an unfertilized "organic" soil, say researchers.

A Physicist's View

Improved soil structure, higher water-holding capacity, and protection against soil erosion are widely accepted attributes of organic matter. *The Furrow* asked W. A. Raney, chief soil physicist with the USDA's Research Service, for his views on them. His terse answer cuts through a half century of traditional thinking.

Raney points out that organic matter is useful in building and stabilizing soil structure but the amount needed "is a very small portion of the total amount present." He adds that in most soils "there is very little effect of organic

matter on capacity of soil to store moisture. Generally, moisture storage is greatest if soil is in a puddled condition and decreases as structure is improved. There is little correlation between soil structure and yield." Soil erosion, says Raney, "is better controlled by surface protection with mulches or crop plants themselves than by schemes designed to increase soil organic matter."

Value of Green Manure

There have been many attempts to add organic matter, hence improve crop yields, by plowing under green manure. After trying seven years, Illinois researchers report no apparent benefit from plow-down rye with continuous corn. It's the same story in Georgia where soils are lower in organic matter. The University of Maryland says a rye and vetch cover crop, for continuous corn on level land, doesn't pay for itself. In Montana tests, green-manure crops didn't help yield of dryland wheat.

Three Connecticut researchers (Downs, Jacobson, Waggoner) checked cabbage and spinach yields, under rotation and green manure, against continuous cropping of these vegetables. Eight-year averages gave the rotation plots a 10 per cent advantage—but yield was not correlated with organic-matter level.

In analysis, the scientists wrote: "One must ask, 'How great is the benefit of a one-tenth increase in yield compared to cost of idle land and production of green manure for burial?' Surely, results of the test are good news. If nutrient elements are added, from mines and factories, vegetables—like corn—can evidently be grown continuously without a large decrease in productivity and with the savings that follow. . . ."

English Experience

At Rothamsted, England, world's oldest agricultural experiment station, a series of plots has been growing continuous wheat for 117 years. Plot 8 gets only mineral fertilizers, yet it yields as much as plot 2, which gets 14 tons of barnyard

Is humus vital for high yield?

The answer is no. Corn yields projected to 400 bushels per acre have been grown in gravel culture with no organic matter. The Iowa test below proves that applied fertility can substitute for humus under certain field conditions also.

	CORN YIELDS	EXTRA FERTILIZER
Normal soil	122.3 bu.	120 lb. actual N
Subsoil	122.4 bu.	180 lb. actual N

Is humus vital for crop quality?

There's a lot of evidence that it isn't, with food crops at least. In the test below, a low-humus Texas soil produced turnip greens with as many vitamins and minerals as did a much richer soil in Oklahoma. (Figures express equivalent units.)

SOIL ORGANIC MATTER	VITAMINS			CAL- CIUM	IRON
	C	B ¹	B ²		
2.16%	1.0	1.3	2.1	124	27.4
.58%	1.1	1.4	2.6	156	21.9

manure every year. "Only a glance is needed to see that the soil of plot 2 differs from the rest," write the researchers. "The difference would generally be agreed on as an improvement, but wheat apparently fails to appreciate this."

These pages have touched briefly on one side of a quietly controversial issue: the role of soil organic matter. You'll find differing opinions, front-rank scientists, and unresolved research on both sides.

As a source of plant food, especially nitrogen, it's clear that organic matter is precious but not necessarily priceless. Other across-the-board attributes—both good and bad—are apparent but hard to pin down. What's good for one soil and climate may be bad for another. There's evidence that fresh organic matter, a by-product of high yields, has more influence on soils and crops than does humus. If so, maintenance of humus may take a back seat—so long as yields stay high.



Land classification, or land-capability classes, as worked out by a soil survey. No. I is good agricultural land; II and III are less so; IV is marginal. Class V, not shown, is better for pasture (too wet or stony for cultivation). VI and VII need a permanent cover of trees or grass, because they are stony, steep, shallow or wet. Going from I to VIII, one's choices in use become fewer and the risks greater.

U.S.D.A. Soil Conservation Service





Courtesy Owens-Illinois

DISCOVER THE ART OF BOTTLE GARDENING

Elvin McDonald

BOTTLE gardening is like having a miniature greenhouse, inside of which you can plant a Lilliputian landscape. Practically any size bottle of clear glass is suitable, provided it has an opening large enough to allow for the insertion of planting soil and plants.

After selecting a bottle, jug or jar for planting, wash it spotlessly clean. You will probably be working through a small opening to clean the inside, and for this purpose a small lintless cloth wrapped around a piece of pliable copper wire or a stick is useful. Do not attempt further work until the interior surface is completely dry.

Add soil to the container by using a funnel. This can be the usual kind, or you can make a tube from aluminum foil, with the end of it reaching nearly to the bottom of the bottle. First add a half-

inch of crushed charcoal to help keep the soil fresh in the close conditions of the bottle, then add spoonfuls of moist, but not wet soil. A mixture of equal parts loam, sand and peatmoss will give good results, or use a commercially prepared medium such as Black Magic Planter Mix. Use a wire or small stick to mold the soil into the terrain you have in mind for your landscape, then make cavities for the roots.

Now you are ready for the planting. First wash away most of the soil from the roots of rooted cuttings or small potted plants. Trim back excessively large leaves, or any growth not in scale with the planting. To insert a plant into the bottle, work carefully, leaf by leaf until it drops into place. You will need patience. If a plant has relatively large and delicate leaves, a miniature rex be-

Adapted from *Under Glass*, The Home Greenhouse Gardener's Magazine,
November-December 1963

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gonia for example, you may find it best to wrap it in a piece of paper or saran, coiling the leaves into a tube small enough to go through the opening. Once the plant is inside the bottle, remove the paper, then set the roots in the proper position.

The number of plants you put in a bottle depends first on size, but also on the effect you are trying to achieve. If you want the appearance of a miniature forest, use more plants than for a formal kind of garden. You will discover that there are low, ground-covering plants for bottle plantings, as well as those of medium height, and tall accent kinds. Select plants with an eye for color and contrast so that fine foliage can be foiled by bold; so that a stiffly erect form can be complemented by a soft rosette. After the plants are in the bottle, move them into position, using a wire or small stick. Sometimes blowing through a drinking

straw is just the trick needed to position a delicate leaf.

The contents of a bottle garden need not be limited to plants alone. You can add pebbles to give the appearance of walks, a shell to represent a pool of water, or even construct a little house beneath the overhanging branches of miniature treelike plants. When the planting is completed, you will need to remove every bit of soil that may be left clinging to the walls of the bottle and to the plants. If the planting medium is moist to begin with, you do not need to add more water at this time, but it will help the new garden to get off to a good start if you will moisten the leaves by misting them with a fogger or atomizer of clean water.

Bottle gardens require the addition of very little water, as moisture condenses on the walls inside and drops back to the soil, but if the soil becomes dry, moisten



Philpott

The start of a bottle garden: *Step 1*, a layer of charcoal, followed by moist potting soil, is poured into a clean, dry bottle through a funnel. *Step 2*, establish the terrain for a miniature scene, and gently manipulate plants through the opening (wrap larger ones). *Step 3*, set plants in place with the aid of a heavy wire or slender stick and firm the soil about their roots with a stick or wire tongs. When planted, the bottle's inside surface and the leaves should be cleaned of specks of dirt.

Plants for a Bottle Garden

There are some plants that definitely thrive in the high humidity of a closed or nearly closed bottle garden. Some of my favorites include such begonias as 'Baby Rainbow,' 'Berry's Autumn,' 'Calico,' 'Smaragding,' 'It,' 'Red Berry,' and 'Winter Jewel.' Other suggested plants include:

Bertolonia, *Calathea*, *Chamaecranthium*, *Fittonia*, *Maranta*, *Stenandrium*, all small greenhouse plants with foliage variously marked and colored
Cissus striata, a small shrubby vine
Dionaea muscipula, Venus'-flytrap
Erythroxes nobilis argyrocneurus, miniature jewel orchid
Ficus repens and *F. radicans variegata*, creeping figs
Polystichum tsus-simense, dwarf holly fern
Pteris ensiformis victoricae, white-banded brake
Selaginella, a fern relative, almost mosslike in appearance
Sinningia pusilla, miniature gloxinia

An even wider variety of plants for bottle gardens seems able to tolerate a completely closed container or an open one with equal success. These include:

Acorus gramineus pusillus, a small grassy-leaved plant related to the native sweet-flag
Adiantum, maidenhair fern
Alternanthera, a small plant with red-blotched leaves
Aucuba japonica, gold-dust plant (young specimens)
Begonia boweri, *B. foliosa*, *B. hydrocotylifolia*, *B. semperflorens* (dwarf varieties), 'China Doll' and 'Medora'
Episcia, a bronze-leaved trailer
Hedera helix, English ivy (small varieties)
Helxine soleirolii, baby's-tears
Hypoestes sanguinolenta, pink polka-dot plant
Impatiens, patience-plant
Malpighia coccigera, sometimes called "miniature holly"
Mentha requienii, Corsican mint
Neanthe bella, dwarf palm
Pellionia repens (*P. daveana*), a small plant with bronze, green and violet leaves
Peperomia, numerous small varieties with decorative leaves
Pilea cadierei minima, aluminum plant
Plectranthus, several species with variously ornamented leaves, somewhat like *Colerus*
Scindapsus, pothos, a trailing plant with heart-shaped leaves, sometimes variegated
Saintpaulia ionantha, African violet (miniature varieties)
Sansevieria, snake-plant (young specimens)
Saxifraga sarmentosa and variety *tricolor*, strawberry-geranium or strawberry-begonia
Scilla violacea, with pewter-spotted leaves, maroon beneath; pale blue flowers
Siderasis fuscata, with rosettes of silver-banded leaves, purple on reverse
Tolmeia menziesii, pickabaek plant
Tradescantia, inch-plant or wandering-Jew, numerous varieties

by adding drops of water. Pouring water into a bottle garden tends to result in the application of too much moisture, and may splash soil onto the glass. It's a

good idea occasionally to mist bottle plants again. About once every two months when moisture is added to the bottle garden, use a liquid houseplant fer-



Courtesy Owens-Illinois

A bottle garden several weeks after planting

tilizer mixed at half the recommended strength. Overfeeding results in growth that is too lush for cramped quarters, but just the right amount helps keep plants in good condition.

As a bottle garden grows, it requires a certain amount of trimming and training to keep the original design. Some plants may outgrow others, and need to be curbed more severely. Pruning plants inside a bottle requires ingenuity. I have even broken a razor blade in half and secured one end of it in a stick so that I could remove a stubbornly fibrous, yellowing leaf from a miniature palm.

If aphids should attack the plants in your bottle garden, discourage them by spraying with one "poof" from a houseplant pesticide aerosol, then closing the opening for a few minutes. Mealybugs can be more destructive in a bottle garden, and harder to control than aphids. Try touching them with a piece of cotton that has been saturated with alcohol and attached to the end of a wire or stick.

Bottle planting is an art, perhaps not as difficult as building a model ship inside a container, but more rewarding to the gardener. One bottle garden always leads to another, for the know-how you gain from the first makes those that follow more successful and more fun.



THE CHARM OF DWARF GRASSES

W. Wright

THERE are quite a few dwarf grasses which can be grown in the rock garden which, while not giving a brilliant display, will provide interest and beauty when flowers are scarce. The following are not invasive, and the dried heads can be used for winter decoration, or for those who practice floral art.

- Briza maxima*, quaking grass
- Briza minor*, dwarf quaking grass
- Festuca glauca* (*F. ovina glauca*), blue fescue
- Festuca glauca pumila*, dwarf blue fescue
- Hordenm jubatum*, squirrel-tail grass
- Lagurus oratus*, hare's-tail grass
- Mibora verna*

Condensed from the Quarterly Bulletin of the Alpine Garden Society, 58 Denison House, Vauxhall Bridge Road, London, S.W. 1, England. For American sources of these tufted grasses, which are grown as individual plants, not as greenswards, see the *Plant Buyer's Guide* published by the Massachusetts Horticultural Society, Boston 15, Mass.

SOD FARMS THRIVE ON LONG ISLAND

Lawn grasses a field crop for landscaping use

Byron H. Porterfield

PEOPLE who are looking for "instant lawns" are turning to the Long Island growers of sod. Increasing numbers of new homeowners are ordering sod lawns for their landscaping. Many established gardeners are resorting to ready-made lawns after disappointments with seeded lawns. New light-industry plants and certain commercial buildings choose sod to produce that matured landscape appearance overnight.

The cultivated sod industry was started in Suffolk County on a small scale in the truck gardening areas in the early 1930's. It has boomed within the last two years

to become a \$2,000,000 industry. Approximately 3,000 acres are devoted to sod production throughout the county.

Robert A. Ingersoll, Jr., an associate county agricultural agent at Riverhead said that there are at least 15 growers with 100 acres or more each in sod and another 15 with fewer acres. Many of the new growers are long-time farmers who have diverted potato and cauliflower fields to the specialized cultivation of sod.

Sod Empire

Louis De Lea of East Northport has been in the business since 1932. He and

From *The New York Times*, July 21, 1963.

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The turf is cut by machine into 1-foot strips, 1 inch in thickness, then into 2-foot rectangles.



Porterfield photos

Stacked sods are loaded mechanically for delivery to customers. To keep them clean, they are piled in pairs with the grassy sides toward each other.

three sons operate the largest sod empire on the Island, 600 acres of carefully groomed grass.

Most of Mr. De Lea's sod is sold to private landscaping contractors. The landscaper can buy sod cut in pads two feet long and one foot wide, stacked for shipment, at a cost of 8 cents a square foot at the present time. The homeowner pays approximately 18 cents per square foot for the completed "instant lawn."

The Anton Hren Nursery at Huntington Station is one of Mr. De Lea's steady wholesale customers. Louis Auletta, landscape designer for the Hren Nursery, said that 90 per cent of his new lawn work in recent years has called for cultivated sod.

"A customer can have a beautiful lawn immediately which might take him several years of work to produce from seed," Mr. Auletta explained. "And he has eliminated the possibility of a poor start after spending much time, money and energy."

Mr. Auletta said that many houses now being built on Long Island are on sloping or hilly ground. On such sites it is difficult to establish a lawn from seed because gullies and washouts often occur before enough grass grows to hold the soil.

Cost of a Lawn

An increasing practice is to pay for the installation of a cultivated sod lawn with a five-year financing plan. The average suburban home on a one-third acre tract will have a lawn area of about 5,000 square feet. According to Mr. Auletta the cost for sodding would be about 18 cents a square foot or \$900 for a completed installation. The price rises to 20 cents a square foot for areas less than 5,000 square feet.

By contrast, if the same size lawn were to be seeded directly the completed cost would be around \$550. This includes the price of a top quality seed mixture (\$35

to \$40) and the landscape contractor's labor charge of 10 cents per square foot.

How Sod is Developed

Using highly specialized methods of ground preparation, seed germination, fertilizing, irrigation and care, a field of cultivated sod is developed and ready for harvesting in one year. Mr. De Lea develops a field of instant grass in the following manner: The ground is prepared by spreading 50 pounds of lime and 25 to 30 pounds of superphosphate on each 1,000 square feet. The potential weed problem is met by spreading 1,000 pounds of cyanamid per acre.

The chemicals are disked into the ground, dampened and the field left dormant for 21 days. During this waiting period the cyanamid sterilizes the soil and breaks down into beneficial compounds.

Then 1,000 pounds of 10-6-4 fertilizer and 35 to 50 pounds of organic fertilizer are applied per acre. The field is carefully graded level and seeded.

Mr. De Lea said that a mixture of 75 per cent Merion bluegrass and 25 per cent Pennlawn fescue has proved to be his



On a slope, the "prefabricated" lawn of sod is not subject to erosion.

most successful sod formula for Long Island lawns. It is sown at the rate of 125 to 150 pounds per acre or two to two and a half pounds per 1,000 square feet.

Harvesting Technique

In harvesting sod, special cutters are used. They are set to cut at one inch to include root mat; actually less than one-half inch of topsoil is removed. The cutters slice strips of sod 12 inches wide. Cross cuts are then made at 24-inch intervals, resulting in two-square-foot pads ready to be stacked for shipment.

Workmen place grass sides together for each layer on the stack to avoid grass and dirt contact. A landscape contractor can either pick up sod at the fields or take delivery from De Lea's specially equipped trucks.

The ground must be carefully prepared for sod. It must be porous with adequate drainage. Lime and superphosphate are tilled in and the ground is dampened to cool it.

The pads of sod are fitted to form a solid carpet without rolling or tamping. The sodded area is soaked deeply every day for at least the first week, then three times a week until grass has grown enough to require mowing.



Photographs by the author

Automatic sprinkling systems water the grass on the 3,000 acres of Long Island's sod farms.

GARDENING WITH CHILDREN

*A means of developing initiative, responsibility,
and a sympathetic interest in nature*

Barbara Matthews

MANY adults blame their lack of interest in gardening on being discouraged when they were children by having to do the tedious jobs that the adults hated doing themselves—mowing, weeding, raking paths, and cutting edges.

The same mistake is made generation after generation. The marvels of nature that a child could be taught to enjoy are lost by adults' lack of real understanding or imagination. The same opportunity is lost by the mother who regards it as too much trouble to look after her toddlers and try to garden at the same time. She has not thought of getting them to work with her in the garden, or perhaps she considers the effort too troublesome. No effort is too great to encourage children to love gardening, because through it a sympathetic interest in nature and a love of plants will remain with them for a lifetime.

You can't start early enough to garden with children; they are great imitators and example is everything. If you use a spade, a hoe, a rake, or a barrow, they will want to do likewise. Replias of these tools in children's sizes are easy to make or buy.

If you are raking up leaves, it is fun to have the children help, and companionship develops which will become a treasured memory. What is the extra weight in a barrow of a small child on top of the load? Or at least on the return journey when the barrow is empty? So to earn the ride the child helps to pick up the weeds and fill the barrow.

If you are planting out annuals let him

help you, showing him how to dig the hole, plant, and water in. Have a few spares handy to replace any losses later when he's out of the way, for a few are almost sure to get planted too deeply, or be broken, but the lesson is worth the cost. If his help is too embarrassing on some occasions, divert him to a plot and give him all sorts of odds and ends to plant there.

The smaller boys or girls have to have a plot where they can do as they like without adult interference. Only in this way will they learn some simple fundamentals. They may dig up the same plant six times and replant it; they will put flowers in without roots, and all sorts of extraneous things like toys, but the plot is theirs. Later they will learn that plants need roots and must be stationary to grow.

Seeds will fascinate children, but let them be seeds that germinate and grow quickly—radishes are good for a start but carrots are better to eat. They may pull them up prematurely and eat the lot raw, but they are good for them this way and they taste twice as good if grown by themselves. Peas can also be eaten raw, and strawberries, of course, are favourites.

A small child can be kept waiting too long for results. Let him have a few annuals to plant that are already in bud, such as pansies. These are fascinating because their "faces" appeal and they provide endless flowers for them to pull.

Here is another way to keep children occupied and from being destructive.

Reprinted from *The New Zealand Gardener*, December 1, 1962, and the
American Rose Magazine, August 1963

Give them a few old vases or jars and allow them to pick—with you—flowers to arrange in them. A basket of mixed flowers—dahlias, pansies, sweet peas, anything that is plentiful, and not treasured by you, but still pretty enough—will fascinate most children, and if mother is busy with arrangements, the children love to do as she is doing. Sometimes the result is quite astonishing, but whether it is good or bad, the arrangement must be given a place in the house where it can be admired by the rest of the family.

One must always be prepared to make certain sacrifices and put up with a few losses, but the child who is made a com-

panion will not do mischievous damage and can be trained from the toddling stage to enjoy working with you in the garden. It is when he is introduced to gardening at the age of eight or so by being told to rake the path or mow the lawn that he resents it. But the toddler brought up to it by "helping" Mum push the mower or carry off weeds will not quibble when it becomes his after-school job. And here again the opportunity should not be lost for companionship and sharing together in the work, for there is something more involved in this than teaching children to love nature and gardening.



Buhle

Gifted teachers (as well as parents) can direct the young toward a love of gardening and nature. At the Brooklyn Botanic Garden Children's Garden, pictured here, boys and girls from 9 to 17 learn about living things and how they grow. These summer gardens were started in 1913, and about 400 children are now enrolled each year. Most of them raise vegetables, which they plant, cultivate, harvest and take home. A flower border also figures prominently in their interests. Working together adds a dimension of social responsibility to the activity.



Crops Research Division, Agricultural Research Service, U.S.D.A.

The first camp of John L. Creech and Francis deVos on their plant-hunting expedition in Nepal, October 11, 1962. The site, reached on foot, is the bed of the Grabun Khola, a main route of travel in winter but a raging torrent during the monsoon.

EXPLORATION IN NEPAL

Longwood Gardens and U. S. Department of Agriculture cooperate in sending scientists Creech and deVos to seek new kinds of ornamental plants

Lee Lorick Prina

THE recent successful plant expedition to Nepal by the United States Department of Agriculture may bring to American gardens many new and unusual ornamentals native to that Himalayan country. This "plant hunt" has yielded 250 separate collections of exotic plants with promise as ornamentals.

Two U. S. D. A. scientists, Dr. John L. Creech and Dr. Francis deVos, made the two-and-one-half-month trip — the first U. S. D. A. exploration of Nepal. Dr. Creech is supervisor of new crops research at the Agricultural Research Center in Beltsville, Md. Dr. deVos is assistant director of the U.S. National Arboretum. Longwood Foundations, Inc., of Kennett Square, Pa., contributed financial support to the expedition.

Region Recently Opened

Nepal, a southern Asiatic kingdom between India and Tibet, remained isolated from the rest of the world until 1947. After foreign visitors were permitted to enter the country, the British and Japanese made botanical surveys for plants of economic value. The recent American research was primarily horticultural, concentrating on the temperate forest area between 6,500 and 12,000 feet.

Although the tiny country is at the same latitude as Florida, most of it is mountainous terrain in the high Himalayas. The area was of interest to the Agricultural Research Service because any typically southern plant species found there are of unusual hardiness.

From *The New York Times*, September 1, 1963

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New Cherry for the South

Among its achievements, the expedition to Nepal made the exciting discovery of a winter-flowering cherry tree. "We were there in November when the foliage generally was dying," Dr. Creech recalls. "Suddenly we would come upon one of these pink-blooming cherry trees standing out among the dried leaves."

This unusual ornamental apparently goes dormant during Nepal's dry season—early fall. The tree flowers in late fall and early winter. It grows vegetatively at a very slow rate during the rest of the winter and spring, during which time the fruit is slowly developing, too. The fruit finally ripens in early summer.

Dr. Creech feels that the tree is a good possibility for the southern United States. The mild climate in that area is not favorable to the normal species and varieties of flowering cherries.

Twenty-one Orchid Species

The expedition was made in the fall in order that the two horticulturists could collect seed. The only live plants brought back were 21 species of orchids.

Several of these species belong to the genus *Pleione*. The tiny blossom (about two inches across) is usually orchid in color but occasionally white with a yellow throat. Although frost had already occurred when the two scientists arrived, they found the Nepal hillsides as high as 7,600 feet carpeted with these ground or terrestrial orchids.

Dr. deVos thinks that these exotic *Pleione* orchids, introduced into Europe several years ago, eventually may be grown outdoors in warmer areas of the United States. Longwood Foundation's subsidiary, Longwood Gardens (the famous Kennett Square horticultural show-place), is doing experimental work on the live orchid plants.

Horticulturists used to have to ship all live plant specimens in the bulky Wardian case designed to protect soil-grown plants during ocean voyages. Now the explorer places his discoveries in sphagnum moss wrapped in plastic film and ships them



U.S.D.A. Photo

New collections of the Himalayan fir (*Abies spectabilis*) from Nepal may extend the range of hardiness of this ornamental purple-coned species. Plants now in cultivation in the United States seldom survive north of Tennessee, Washington, D. C. and Delaware.

back to the United States by air.

The U.S.D.A. expedition collected tree seeds from Nepal's rich forests of maple, fir and oak. The maples are small and seem to have promise as ornamentals. "A yellow maple with key-shaped seed pods which hang down in bright reddish-purple clusters is particularly attractive," Dr. deVos said.

Hardier Rhododendron, Magnolia

Among broad-leaved evergreens discovered by the expedition was a pink-blooming tree rhododendron found at 10,000 feet. This plant could widen the hardiness range of the rhododendron clan in the United States, the government scientists reported.

Another "new" species of a familiar plant which may prove more hardy than those now in use is a magnolia which Dr. deVos found at 9,000 feet. Known as *Magnolia campbelli*, it is a very large deciduous species originally introduced into the United States from India in 1909. The Nepalese specimen may extend the growth area of this species. It will join the ranks in the magnolia breeding pro-

gram at the U. S. National Arboretum.

Though Nepal is about the size of North Carolina, there are only about 237 miles of paved roads. The two-man team did most of their exploring on foot.

The group slept in tents, camping at 9,000 feet in the foothills of the Annapurna range. Porters back-packed food supplies from Katmandu, Nepal's capital.

The party covered only a small area each day, finding the land rough and rocky. "There were no 50-mile hikes for us," Dr. deVos commented. "We felt fortunate to make 35 miles in one day."

The explorers depended on their background knowledge and curiosity to find plants growing wild in the remote country. But before beginning their horticultural quest, the scientists received assistance in locating good exploring grounds from Dr. G. A. Herklots, a British botanist who was in Katmandu in his role as director of the newly created Royal Nepalese Botanic Garden.

Vegetable Seeds being Gathered

Members of the United States Agency for International Development (AID) in Katmandu also helped. "The AID mission

is collecting seeds of all the native vegetables of Nepal for us," Dr. Creech explained, "so that plant breeders in the United States will have valuable new material to work with."

The expedition made four major studies of the west-central part of the country. The team first surveyed forests and meadows as high as 12,000 feet along the foothills of the Annapurna range. Other treks were made along the Kali Gandaki and Mardi Khola rivers and in the hill country near Katmandu.

As for the ornamentals brought back from Nepal, at the moment the fall-flowering cherry tree seems to have the most brilliant future. But time may change this. Like most scientists, the Creech-deVos team is taking a "wait and see" attitude about their collection.

Some of the plants are as yet unidentified. Those that seem impressive now may not be the ones that prove most valuable when they are propagated, tested at arboretums and later distributed for trial in different parts of the country. It will be about five years before any of the expedition's discoveries will be available to the general public.



Crops Research Division, Agricultural Research Service, U.S.D.A.

Cleaning seeds of *Magnolia campbelli*, an extra-hardy form of which was found in Nepal. *Magnolia* breeding programs will make use of this discovery.

LAND PRESERVATION AND THE LAW

MANY thoughtful citizens have a desire to save the unique qualities of untouched landscape, to assure that future generations will have access to such natural areas, or wild parklands, which might otherwise fall prey to "development." Mr. Brenneman's article gives legal know-how for such action.

Russell L. Brenneman

SEVERAL months ago I was asked by The Conservation and Research Foundation to conduct legal research into the ways in which individuals and groups can through private means perpetuate land use patterns. When I speak of "private" methods of accomplishing this objective I, of course, mean to distinguish between individual efforts and government action. These remarks will be a very brief summary of some of the approaches which can be considered, but I must caution you at the outset that the laws of the various states differ so substantially that very few general statements can be made, and you should consider a particular approach or combination of approaches only upon the advice of counsel in the local jurisdiction. Also, it is obviously impossible to concoct any formula technique or formula language useful in every situation. Just as every natural habitat differs from every other, so the legal approach to preservation of the habitat will differ from case to case.

Conservation Easements

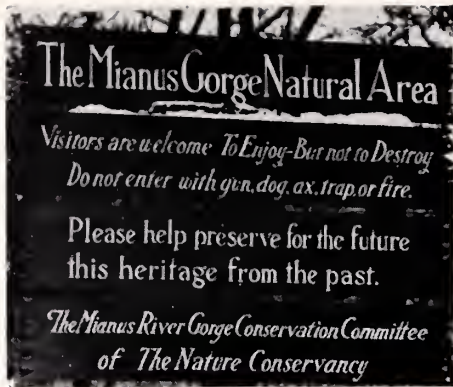
One of the techniques which has received considerable attention recently is that of the conservation easement. The acquisition of such an easement by public authorities has been authorized by the green belt and open space legislation of several states. There is no reason that

private agencies cannot use the easement approach as well. Some property over which The Nature Conservancy has a conservation easement in Connecticut is the Gallup Marsh in the Mystic River. In 1961 Mrs. Gallup granted The Nature Conservancy the right to use this marsh "as a nature preserve for recreational, educational, or scientific purposes, in substantially its wild, natural character."

A conservation easement which has been used in Ohio grants the donee of the easement, a college, "the right and easement as a conservation easement to hold and protect" the premises described "forever as permanent woodland and other open tree-space for the protection of unspoiled natural beauty in the within described and adjacent areas." I quote from the language of these easements because they show some diversity of approach and make the point that the language of the granting instrument can and should be tailor-made to the particular situation.

An important thing to remember with respect to such an easement is that it creates an interest in the land itself, and the holder of the easement has standing to object to interference with the easement by anyone. For instance, it seems to me that if such an easement were threatened by the aerial spraying of pesticides the holder of the easement would

Address given at the 14th annual meeting of The Nature Conservancy at Connecticut College, New London, Connecticut, August 24, 1963. Reprinted from *The Nature Conservancy News*, Fall 1963.



have standing to object. When the value of the Mystic River marsh as a natural area was threatened by a proposed marina nearby, The Nature Conservancy was able to participate in the administrative and court proceedings directed at stopping the marina, and it was never questioned by any court or agency that The Conservancy had standing to do so.

This notably distinguishes the Gallup case from such cases as that involving Sherwood Island in Connecticut, where it is my understanding conservationists attempted to appear in court to object to the effect of the proposed project on the natural area. The court held that the conservationists could not do so because they had no standing in court, they not having an interest in the land.

Restrictive Covenants

Another approach to restricting land use is by the imposition of restrictive covenants. When I speak of "restrictions" or "restrictive covenants" I am referring to covenants enforceable in a court of equity. Such covenants can be imposed in a deed to property. An owner could grant a parcel of land and impose in the grant a covenant that, say, the plant and animal habitat would not be modified.

More interesting to me is the possibility of using reciprocal restrictions on a number of parcels of land with a number of different owners where the parcels have some conservation value in common. An example might be where several proper-

ties lie on either side of a stream and it is desired to preserve the stream value. The neighbors holding property along the stream could reciprocally covenant among themselves not to modify the habitat in a strip of land lying, say, within 1,000 feet of the center of the stream on either side. This type of restriction, it seems to me, lends itself particularly well to valley situations and perhaps to the shore line. I think that I should immediately add that the law with respect to covenants is not at all uniform or well settled. There are very great diversities in the laws of the several states and even within a state and it may be very difficult to discover just what treatment such covenants would receive should they ever be viewed by the courts.

I am trying to be as untechnical as possible, but I think that I must interject here a somewhat technical point. This concerns easements and covenants the benefit of which is held in gross. When we lawyers use the phrase "in gross" in such a context we mean that the covenant or easement does not benefit and is not appurtenant to another piece of land. Where an easement or covenant in gross is contemplated, very close attention must be given to the validity of such an interest under the law of the jurisdiction where the interest is to be created. The law of the various jurisdictions on this subject is both unclear and diverse. In any jurisdiction where it is doubtful that such interests in gross are recognized, it would be advisable, it seems to me, to grant the conservation agency a parcel of land to which the easement or covenant could be appurtenant and which the easement or covenant would benefit.

Tax Considerations

I think that we ought to touch briefly on aspects of easements and covenants having to do with the deduction for charitable contributions under the Internal Revenue Code. Conceptually, the gift of an easement to a tax exempt organization certainly constitutes a charitable contribution, and the Tax Court has so held in at



Gottsche-Schleisner

This meadow and woodland are part of a 220-acre tract in Westchester County that has been entrusted to the Brooklyn Botanic Garden to perpetuate largely in its natural state.

least one case. I should think there would be more question about the allowance of the deduction where an equitable servitude is imposed, although the line may be a fine one. In both cases there will very likely be the problem of valuation of the interest transferred to the charity.

The Time Element

I think I should also add, with respect to covenants, that several jurisdictions have laws affecting the type of covenants which will be enforced and the duration of covenants. Thus it may be that under the law of a particular state a covenant is good only for a specified period of time. Or, the law may provide, as it does in Massachusetts, that the covenant must be in effect renewed from time to time if it is to continue to have legal force.

Passing from easements and covenants, land use may also be controlled by the use of a grant with a clause conditioning the grant on the continuance of a specific state of affairs. An example might be a deed which transfers land on condition that the plant and animal habitat will not be modified. If modification occurred, depending upon the language of the instrument, the property could revert automatically to the donor or grantor or the

grantor could have a right to enter upon the land and take possession of it for himself, or title to the property could pass automatically from the original grantee to another party. While in a particular situation this approach may be an appealing one, its usefulness would be extremely restricted by the laws which have been passed by an increasing number of state legislatures limiting the duration of such conditions. Typically, such statutes provide that where such a grant is made and the condition does not occur within a specified time after the grant, the title of the grantee becomes absolute; that is, the condition is no longer of any effect.

Court Reactions

After discussing these easements and covenants I must immediately add that I have been able to find no case in which a court of law has passed upon the validity of such a restriction or covenant. In imposing such limitations privately upon the land we are, in effect, withdrawing it from the market place and saying that regardless of what economic value society may place upon the land or what its most productive use might be, it is to be preserved in its natural state.

It has often been said that restrictions

upon land use are not favored by our law because it is the policy of our law to favor the freest possible transfer of land for the purposes for which it will fetch the most in the market place. The social desirability of the restrictions which we seek to impose may seem obvious to us—and I hope it will seem obvious to future generations—but I think we must assume that any restrictive approach will be examined critically by the courts.

I am not particularly concerned about the enforcement of these restrictions in this generation or even in the next, when there will still be relatively close contact with the time when the restrictions are imposed. But I am concerned about enforcing these provisions in the third generation, when, we may be sure, the pressure on these resources will be infinitely greater than it is now and the parties against whom enforcement is sought will be more remote from our time. By this negative talk I do not wish to suggest that we should not go forward and pioneer in this area, but I do think that we must move with the utmost care in order to insure that our objectives are accomplished.

Ways of Giving Land

I am going to touch very briefly on a few points concerned with gifts of the land itself. I think that we should remember that where a donor wishes to give some land but also wishes to retain an interest in it for his life or for the life of himself and his wife, he may do so by reserving a life estate in himself or himself and his wife. There would be a present gift of the remainder interest and if the gift was to a tax exempt organization the value of the remainder interest would be deductible as a charitable contribution at the time of the grant.

Sometimes a donor wishes to give land, but for tax reasons he does not wish to give the entirety of it in any one year. If he wishes to give it, say, over a period of five years, he can, of course, physically segregate the land into five parcels and

give one of them each year to the conservation agency. A less cumbersome way to accomplish the same objective is to give an undivided one-fifth interest in the land to the conservation agency each year for a period of five years. Of course, his will should provide that if he should die prematurely whatever interest he has not given prior to his death shall pass to the conservation agency. It seems to me that this second method has much to commend it and lawyers who know a lot more about federal taxation than I do say that such an approach does not jeopardize the charitable deduction.

Gifts in trust may be either given while the donor is living or by a provision in his will. The great virtue of a trust is its flexibility. You may include provisions in a trust instrument which would be out of place in a deed for the reason that our land law has developed historically in a much less flexible manner than the law of trusts, which is of more recent origin.

In closing, may I speak briefly about the role of the lawyer in conservation efforts. It pleases me very much to find that Messrs. George Collins and Richard Leonard in San Francisco are in the process of organizing a national group of lawyers who are concerned about and willing to work in the conservation area. There is a great deal of information, opinion and knowledge which should be shared among lawyers of all the jurisdictions if our profession is going to help conservationists achieve their goals.

Remember that the role of the lawyer is both creative and defensive. It is creative in the sense that he must put the conservation agency in the best possible position with respect to its holdings by setting up those holdings in a form which will insure the greatest likelihood of accomplishing the conservation objective. The lawyer's role is, of course, also defensive in the sense that when these preserves are threatened by eminent domain, by trespass or by some other encroachment, action must be taken in the courts to protect them.

GLAMOROUS WEEDS

*The farmer's plague
is frequently the
photographer's
delight*

Samuel H. Gottscho

Photographs by the author

AN exclusive jewelry shop in New York displayed in its Fifth Avenue show window some years ago several flowers against a black velvet background. Passers-by were fascinated. Some, I know, even wondered about the identity of the flowers, assuming that they must be an exotic variety from luxuriant islands of the Pacific.

The botanically informed, however, recognized the plants as Queen Anne's lace, or *Daucus carota*, abundant in mid summer even in the city's vacant lots.

Despite its fragile beauty Queen Anne's lace is regarded by the farmer as a pernicious weed, just one of many that have come from abroad to plague him by usurping his fields. He is just in his complaint and I sympathize with him, yet to the nature lover and discerning photographer these unwanted blossoms are of great beauty and an integral part of the July and August landscape.

Wildflower and other nature photography is an avocation with me. My vocation is that of a professional photographer of architecture and gardens, so my approach to nature photography is pictorial rather than botanical. Weeds appeal to me for their sturdy independence and their interest as camera subjects.

For many years I have enjoyed photographing our common thistles, *Cirsium vulgare*, that take over abandoned fields and waste places. Their lovely light magenta flower heads and the spiny armor which protects them intrigue me.



An example of Nature's artistry, Queen Anne's lace (*Daucus carota*).

In my neighborhood, on an abandoned golf course where 20 years ago the fairway was crowded with people, now only the song sparrow, the meadowlark or the quaint ditty of the field sparrow breaks the silence. The course is covered with bayberries, sumac, wild cherries and many species of wild grass.

Last July I noted there the orange milkweed or butterfly-weed (*Asclepias tuberosa*), a species I have known for many years. Its orange blossoms attract myriads of bees and butterflies, especially the monarch and swallowtails, who sip the rich nectar.

Of our four species of milkweeds the early-blooming, common *Asclepias syriaca* is much less attractive than the other three—the orange, swamp and blunt-leaved milkweeds, which bloom later. Yet occasionally you may find a cluster of the common milkweed which is a more vivid pink than the usual brownish-pink umbels, and it will have considerable beauty, vying with the lovely pink of the swamp species.

One day in late July, I climbed our hill and noted how the fading plants marked the swift march of time. By this time the Queen Anne's lace is at its peak and any nature photographer should be excused for singing its praises. Against a dark

Condensed from *Audubon Magazine*, July-August 1963

background the exquisite tracery is as delicate and intricate as the lace for which it is named. When the flower is seen from below against a blue sky, the plant's fragile symmetry and intricate strength provide an excellent example of nature's perfection as a designer. This beautiful plant and other glamorous weeds might well be known today as wild flowers *par excellence*. Perhaps the time will come when they will find growing space so limited that they will be fully appreciated for the great beauty which they give to outdoor America.



↑ Samuel H. Gottscho, at 88 (in 1962), waited two hours for a butterfly to alight on a clump of butterfly-weed.

← This is the picture Mr. Gottscho took when the butterfly came,

THE THREAT TO THE GREAT TREES

*California redwoods, a country's natural
and spiritual resource, are in danger*

Brooks Atkinson

DRIVE north on U. S. 101 from Orick and you pass southbound lumber trucks at the rate of about one a minute.

Some of them are carrying redwood boards fresh from the mills. Most of them are carrying 40-foot sections of redwood and Douglas fir logs. Three logs are a full load in many cases. But some of the redwoods are so enormous that one log is as much as the rig can carry. For the redwood is a massive column of timber that in some instances rises more than 300 feet and is from 15 to 20 feet in diameter. With its relative, *Sequoia gigantea*, it is the noblest tree in the world.

The interminable parade of flat-bed trucks and trailers on the way to the sawmill indicates the speed with which the remaining virgin redwoods in private hands are being cut and sawn. Once they stretched in a narrow band for hundreds of miles along the Pacific Coast to Oregon. Like most American natural resources, they seemed inexhaustible when men first started to cut them. But most of the redwood lands in Northern California have now become monstrous boneyards, full of giant stumps and hideous slashes on ground scuffed and torn by caterpillar tractors.

Of the redwoods that still stand after one or two thousand years of continuous existence, the State of California now protects about one-tenth. These are the lordly groves that thousands of Americans have bought through the good offices of the Save the Redwoods League, which has been in existence since 1918. Despite the generosity of the public and the goodwill of the State, the League has never

been able to fulfill its original program because the commercial value of the redwoods has increased enormously—in one case by 100 times. In another 10 or 15 years (estimates vary) all the virgin redwood stands in private hands will have been trucked off to the sawmills, leaving in state hands a few scattered groves that will memorialize a lost American grandeur.

Using the counsel of a quiet man of solid character, Newton B. Drury, the league does not blame the lumber companies for cutting their own property. Americans use redwood lumber because it has several unique qualities. Virgin redwood stands are worth millions. It has been estimated that an average redwood is worth \$1,500 on the stump. In the circumstances, the lumber industry has a right to take its trees to market. And the biggest lumber companies adhere to enlightened forestry practices by leaving seed trees in the cut-over areas and ensuring second growth which will become merchantable timber in another 100 years.

But the public also has an interest in these unique trees. They dramatically illustrate the relationship of the human being to nature and to the history of civilization. The virgin redwoods constitute a natural resource that is still alive. Unlike their relatives the giant sequoias, the redwoods (*Sequoia sempervirens*) have never had the protection of the national park system. And although the State of California values them officially and culturally it permits the state highway department to fell trees to build
(Concluded on page 47)

From Brooks Atkinson's column "Critie at Large" in *The New York Times*, January 7, 1964.
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NATURAL LANDSCAPING WITH HERBICIDES

The most attractive wild plants can be encouraged by selective spraying of less desirable kinds with chemicals harmless to wildlife

William A. Niering and Richard H. Goodwin

WILD or unused land in various stages of natural revegetation may possess great charm or may have tremendous aesthetic potential, if skillfully manipulated and maintained. Attractive native species of plants are usually growing spontaneously in such areas and only need encouragement through selective removal of the less desirable species that are crowding them. Here herbicides provide the owner with a technique for enhancing and maintaining the beauty of his property with a minimum of effort and expense.

In order to get the most out of a natural tract of land one should first take an inventory of the native species that are already present, their location, condition and potential size. Some may already be fine specimens and well placed, some may only be seedlings, and still others may be malformed or diseased. With this information in mind, plan the type of effect you wish to achieve—an open meadow dotted with specimen trees and shrubs, a screen from the highway or neighbor's yard, a shrub border at the edge of a woodland, swamp or pond. There are as many possibilities as there are tracts to be landscaped. Often enough attractive and interesting species will already be present, but if not, more can be planted. Native species are ideally suited to the climate and require minimum care.

Wherever weedy or otherwise undesirable trees, shrubs or vines are present, these plants may be selectively eliminated by appropriate treatments, *e.g.*, trees

can be cut down, and the stumps treated with an herbicide to prevent resprouting (*stump treatment*). Or, if desired, trees can be notched or frilled at the base with an axe and the notches or frills treated (*notch/frill treatment*). In this case the tree will die standing and can be removed later or allowed to rot and fall, depending upon the circumstances. Shrubs, too, can be cut and stump-treated or the herbicide applied directly to the bases of the stems (*basal treatment*). Vines, briars



Basal treatment, one of three practical methods for eliminating unwanted woody plants through use of herbicides. The lowermost twelve inches of the stems of shrubs (or the trunks of small trees) are sprayed until the herbicide soaks down around the root collar at the ground line. One part of the herbicide (2,4-D and 2,4,5-T together, commercially available as "brushkiller" everywhere) is combined with 20 parts of kerosene or other fuel oil for effective kill of most woody species.

Condensed from "Creating New Landscapes with Herbicides: A Homeowner's Guide." Bulletin No. 14, The Connecticut Arboretum. Available for \$1 from the Arboretum at Connecticut College, New London, Connecticut. Discount given on quantities sent to one address.



NOTCH - FRILL

In the notch and frill treatments, tree trunks are notched with an axe (as at left) or frilled with shallower cuts (right), and the exposed wood is soaked with the kerosene-diluted herbicide. As an alternative, Ammate crystals may be placed dry in the cuts.

and brambles may also be selectively eliminated with the use of chemicals. Details concerning the types of herbicides and methods of application are discussed in detail in this bulletin.

Whenever it is practical, pulling young plants or seedlings by hand is to be preferred to the chemical approach. Non-sprouting species, such as the majority of the conifers, will obviously not require a chemical application.

If care is exercised, it is possible to eliminate the undesired species with almost no damage to adjacent vegetation. Thus, crowded specimens may be released, vistas opened up, and handsome plants made focal points or given the optimal surroundings for effective display.

The natural vegetation can also be manipulated by weed-killers in order to create or maintain various types of wildlife habitat. Different environments, such as dry fields, wet meadows, semi-open fields and thickets, support distinctive types of wildlife.

A grassland can be maintained by occasional mowing, by selectively spraying the woody species with herbicides as they



STUMP

To keep a recently felled tree from re-sprouting, the stump may be treated with the herbicide. Soak bark until the liquid runs down to the root collar. Or, place Ammate crystals directly on the stump's cut surface.

appear, or by a combination of these methods. To maintain a thicket, trees, which would eventually shade out the shrubs, must be removed by basal, notch/frill, or stump techniques (see illustrations).

In the small woodlot or forest plantation, chemicals are useful in eliminating undesired competitive species. They can be used to good advantage in thinning an over-stocked stand where stem density is too great to permit successful development of individual trees. In Christmas-tree or other plantations, competing hardwoods can be readily removed with herbicides. The techniques to be used are essentially those illustrated here.

At the Connecticut Arboretum, two areas have been successfully landscaped with herbicides. The principal chemicals used have been the phenoxy compounds, including 2,4-D and 2,4,5-T, Ammate and aminotriazole. They are all subject to breakdown by microbial action and hence probably have no cumulative residual effect on the soil or food chain. Arsenical compounds and soil sterilants are not recommended.

In snowy climates why not

PLAN FOR SNOW

Henry B. Aul

THERE are many ways to accommodate a modern snow remover, even when the one-car attached garage is filled with cart or wheelbarrow, lawn mower, plant food spreader and all the other accoutrements to suburban property maintenance. One of the best is to house it in a movable lean-to in the service yard alongside the garage. This method is outlined in the accompanying plan.

The shed is a braced and bolted frame of two by threes with 4- by 8-foot panels of exterior type plywood or tempered hardboard forming the roof and outside wall. Ends are canvas drop curtains snapped into position. At this season the lean-to is moved into the position shown, with the garage as the inside wall. During the warm months it is relocated in a corner of the yard where the 6-foot screen fences shelter it on one end and one side. Both winter and summer the machine is protected further with a canvas or plastic cover. The gravel-surfaced service yard forms a well-drained floor.

Winter Convenience

In the winter location, the machine is just a step or two around the corner of the door leading from the garage. Canvas end pieces are unsnapped and the plow is driven directly out of the shed, through the opening between the garage and service yard screen onto the entrance court.

Lawn and plantings adjacent to the entrance court are planned to take deep deposits of snow. The three trees located around the court have their side branches removed six to seven feet above the ground. Snow can be piled around their main trunks without doing any damage. The periwinkle, English ivy, Japanese

spurge or other low ground cover under the trees also can take snow in depth.

No evergreen trees or shrubs with branches and foliage close to the ground are located on the lawn or in other positions that will get in the way of snow thrown, plowed or blown from the court or pavements. A specimen evergreen shrub planted close to the entrance porch is set in a masonry planter raised 12 to 18 inches above the court.

After the front areas have been cleared, the snow remover is driven back into the service yard and a path is opened up around the lean-to and along the end of the garden terrace. Then the machine is turned around and driven back into its shelter so that it is headed toward the entrance court and ready for the next snow. Or, a single turn may be taken around the garden path and across the terrace to the storage quarters.

Early Spring Enjoyment

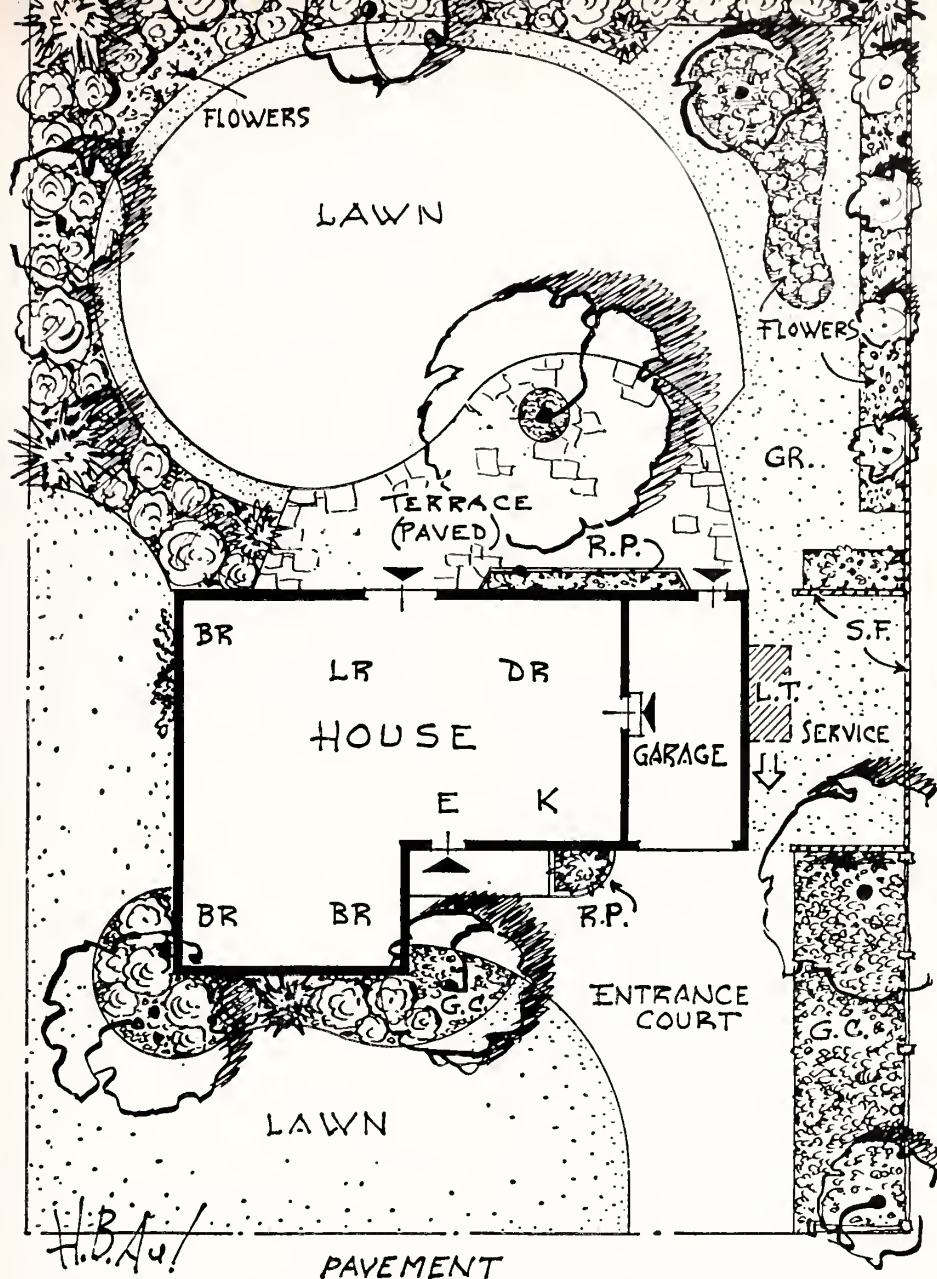
Not every snow needs to be removed from the garden path and terrace but, towards spring, it is desirable to have these areas dry under foot when there are early bulbs to be enjoyed.

A terrace built level with or just a few inches above the surrounding garden is easily cleared of snow so that warm, sunny, February days can be enjoyed in a comfortable lounge or chair wrapped in a steamer robe. Where the paving is a step or two above the grade, a movable plank incline is built to support snow removal equipment. One incline is used to run up on the paving and then moved to the opposite side to permit running off. The raised bed along one side of the terrace clearly marks the limits of this planting.

The design for this 90- by 125-foot

From the *New York Herald Tribune*, October 27, 1963

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Home landscape design laid out for easy snow removal, with a portable lean-to (L.T.) to house the equipment. Gravel (GR) in the service yard, with a screen fence (S.F.) at the edge; low ground covers (G.C.) beside the entrance court, and raised planters (R.P.) where foot traffic is heavy, all help to keep obtruding branches from the plow's path.

property also makes it easy to mow both the garden and the front and side yard lawns. Not a single specimen plant interrupts the open sweep of all lawns. There is no dearth of planting, but all

plants are contained within well defined planting areas. Ground covers help fill out these groups, beds and borders.

A home ground built along these lines is easy to maintain winter and summer.

IF SHORT OF GARDEN SPACE—

*Consider hanging baskets
and cascading plants*

Elsie Louise Sculthorp

RUNNING out of room in your garden? Frustrated because it doesn't hold all the plants you would like to try?

But have you considered air space? Hanging baskets under trees, fastened to the sides of the house (perhaps on each side of the front door), attached to the garage wall, to fences, along a covered walk, under a grape arbor or on a terrace



Jeanette Grossman

Slatted boxes filled with fuchsias hang above potted petunias and geraniums to create a garden effect at the entrance to a house where ground planting space is limited.

Roche

Ceramic pots supported on the wall by ornamental brackets add to the indoor planting space around a window in the confined area of a staircase. The pots contain plants of *Begonia glaucophylla*.

or balcony-terrace—there you have additional planting room without taking up any space. With hanging baskets you can have plants even if you have no garden at all.

Instead of using regular hanging baskets, you may prefer to use an ordinary flower pot, such as terra cotta, or perhaps a glazed pot in a wall bracket. This will serve essentially in the same capacity as a hanging basket.

There are three types of baskets: wire, redwood and ceramic. Wire is most commonly used. Because it is open, it must be lined to hold the soil. Sheet moss or unmilled sphagnum is generally used. Both kinds of moss will absorb a great deal of water, then give off moisture as

the plants use it. Redwood and ceramic containers need no lining. Water evaporates less rapidly from these than from a wire basket, and as a consequence they need less frequent watering.

What to plant? Usually trailing (weak-stemmed) plants are used; many upright

plants will do as well, the two in combination often making an effective arrangement. With wire baskets, as you fill them with moss and loam, you can stick a few trailing plants through the moss and into the loam, on the sides and bottom, in addition to planting the top of the basket.

Some Good Plants for Hanging Baskets

Common Name	Botanical Name
Maidenhair fern	<i>Adiantum cuneatum</i>
Golden-tuft; basket-of-gold	<i>Alyssum saxatile</i>
Rock-cress	<i>Arabis alpina</i>
Asparagus-fern	<i>Asparagus plumosus</i>
Begonia	<i>Begonia</i> , all species
Tuberous begonia	<i>Begonia tuberhybrida</i> , hanging basket form
Browallia	<i>Browallia speciosa</i>
Basket bellflowers	<i>Campanula garganica</i> , and others
Rosary-vine	<i>Ceropegia woodii</i>
Spider-plant; airplane-plant	<i>Chlorophytum elatum</i>
Chrysanthemum	<i>Chrysanthemum</i> , trained to cascade
Cissus or trailing-begonia	<i>Cissus discolor</i>
Trailing queen	<i>Coleus pumilus</i>
Columnnea	<i>Columnnea gloriosa</i> or <i>C. hirta</i>
Kenilworth ivy	<i>Cymbalaria muralis</i>
Sweet William	<i>Dianthus barbatus</i>
African daisy, or Cape marigold	<i>Dimorphotheca aurantiaca</i>
Episcia	<i>Episcia cupreata</i>
Fuchsia	<i>Fuchsia</i> , all trailing kinds
English ivy	<i>Hedera helix</i>
Baby-tears	<i>Helxine solieroli</i>
Wax-plant	<i>Hoya carnosa</i>
Prostrate kalanchoë	<i>Kalanchoë uniflora</i>
Trailing lantana	<i>Lantana montevidensis</i>
Hanging lobelia	<i>Lobelia crinus pendula</i>
Coral gem	<i>Lotus bertheloti</i>
Rose-of-heaven	<i>Lychnis coeli-rosa</i>
Wire-vine	<i>Muehlenbeckia complexa</i>
Ground-ivy	<i>Nepeta hederacea variegata</i>
Boston fern	<i>Nephrolepis exaltata bostoniensis</i>
Cupflower	<i>Nierembergia caerulea</i>
Blue oxalis	<i>Parochetus communis</i>
Ivy geranium	<i>Pelargonium peltatum</i>
Balcony petunias	<i>Petunia hybrida pendula</i>
Heartleaf philodendron	<i>Philodendron cordatum</i>
Hare's-foot fern	<i>Polypodium aureum</i>
Brake fern	<i>Pteris cretica</i>
Trailing African violet	<i>Saintpaulia</i> varieties
Strawberry-geranium	<i>Saxifraga sarmentosa</i>
Blue selaginella	<i>Selaginella uncinata</i>
Black-eyed Susan vine	<i>Thunbergia alata</i>
Nasturtium	<i>Tropaeolum majus</i>
Verbena Peruvian flame	<i>Verbena peruviana</i>
Periwinkle	<i>Vinca major variegata</i>
Wandering Jew	<i>Zebrina pendula</i>
Christmas cactus	<i>Zygocactus truncatus</i>

Condensed from *House Beautiful*, May 1963

See photo, page 53.

HOBBY GREENHOUSES

Basic costs and heating problems

Walter F. Nicke

TWO factors of importance to prospective owners of hobby greenhouses are generally overlooked or not well presented. One is the actual initial expense; the other is the heating problem.

In stating cost, the greenhouse manufacturer is likely to quote merely the barest minimum, without mentioning heating and other equipment that has to be installed. There is really nothing in costs to hide; the hobby greenhouse is worth every penny of the cost and more—but not to everyone. Therefore the whole expense should be made clear, in order not to draw in a buyer who cannot afford it or who does not wish to invest that sum.

How to heat a hobby greenhouse is perhaps the most important aspect of the operation, and in cold climates it is hard to know what heat to use. My own house has an oil space heater run with thermostatic controls, and it does the job well. An automatic blower system circulates the heat. Burner and blower are both inexpensive.

I seldom see a pot burner suggested for greenhouse use, yet I find mine efficient and economical. My house is about 10 x 16 feet, plus a potting shed. We get winter weather with our share of below zero readings, and the house is exposed to winds. For heating it I figure about \$100 to \$125 a year.

The burner has a pilot light, also a fan, the switch for which is activated by the burner's heat. Oil flow is controlled by a simple, foolproof device.

A chimney for such a burner can easily be built of cement blocks. Because my greenhouse is overly exposed to prevailing winds, I also have a tin wind-guard mounted on the chimney.

Besides the fan of the burner, I use an ordinary electric room fan, and have both attached to the same switch. (In a smaller house the stove fan might be

adequate.) I consider the fan the most important part of the equipment. It is placed high on a shelf so that it directs the hot air the length of the greenhouse. But because conditions vary in different houses, it is best to try out the fan in different positions before installing it. The brisk air circulation that it gives is good for the plants. Foliage dries out well and I have few fungus diseases. The forced air circulation gives an even house-wide temperature, and there is little stagnant atmosphere such as greenhouses often get. Whatever heat the fan does not pick up from the stove keeps the potting shed warm.

The thermostat is at the opposite end of the house from the stove. Its placement, too, can be successfully determined only by the trial and error method.



When winter is over and weather is suitably warm, fuchsias and other basket plants can be moved outside the greenhouse and suspended from the framework, where they will benefit from "living" outdoors.

Taloumis



HEDGE PLANTS THAT BEAR EDIBLE FRUITS AND NUTS

Ideas for informal plantings in all sections of the country

Jerome Olds

IF you have room for a hedge, plant one that offers both beauty and a harvest. There is no reason to content yourself with a common hedge of privet when you have so many food-bearing hedges to choose from.

We have just completed a nation-wide survey of state horticulture departments and commercial nurseries on the best double-purpose plants for hedge use. Top choice of these authorities is the high-bush blueberry (*Vaccinium corymbosum*), one not generally known as a hedge plant even though it can be easily trained.

Prof. Arthur Thompson of the University of Maryland suggests using one of the following blueberry varieties (listed from early to late in order of ripening): 'Earliblue,' 'Blueray,' 'Berkeley,' 'Herbert' or 'Coville.' These varieties have very large fruit, vigorous growth, and are winter hardy from North Carolina to Michigan, and from Massachusetts to the Pacific Northwest. They are relatively free from insect and disease damage, the most serious problem being to keep the birds from making off with the fruit.

A blueberry hedge can vary from 3 to 6 feet high depending upon the variety. Plants should be spaced about 3 feet apart, instead of the usual 6 feet. Their white flowers, blue berries in summer, fall-colored foliage and thick growth make them an excellent row planting. They grow best in an acid soil, rich in organic matter, but even do well in midwestern alkaline soils when mulched with sawdust, leaf mold, peat moss or wood chips.

Bush Cherries

Another recommendation from the experts is the Nanking cherry (*Prunus*

tomentosa). Its buds open into white blossoms in early April, followed by long ropes of bright red fruit of cherry flavor by mid-July. Growers report that the Nanking cherry often bears fruit the second year after planting, and it is hardy for northern Minnesota. Fruit is hidden from the birds inside the bush, and the plant is not troubled by leaf spot or insects.

The Hansen bush cherry is also hardy and bears tasty fruit, but is not as widely recommended for hedge use as years ago. These bushes do well in poor soils, grow 4 to 5 feet tall after two to five years.

Raspberries and Blackberries

A kind of informal hedge can be managed with raspberries and blackberries, but Laurence Manning of the Kelsey Nursery cautions that the pruning problem may be rather strenuous as both tend to take over an area. Even more so is the boysenberry. "If the hedge is entirely within your own property, the problem can be managed nicely; if it's at the edge, you may find it difficult keeping the hedge from intruding on your neighbor's grounds."

The new Darrow blackberry is considered promising. Sumner and Willamette raspberries have also been recommended.

Maintaining the hedge shape is the difficulty with all these fruiting plants, Manning points out. Ordinary pruning would remove many of the buds which would form flowers and fruits. Therefore you must leave the tops untouched and prune the sides selectively, rather than with a hedge clipper . . . that is, the main body of the hedge is left unpruned.

Condensed from *Organic Gardening and Farming*, September 1963

Other Fruits for Hedges

Here are a few other bush fruits suggested by many of the persons contacted:

Highbush Cranberry (*Viburnum trilobum*)—makes a bandsome, 10-foot flowering hedge; white flowers are followed by large clusters of bright red berries which hang on way into winter. Berries make bright red jelly with distinctive musky flavor. Fine as winter food for birds.

Juneberry or Downy Shadblow (*Amelanchier* species)—grows 10 to 12 feet tall with attractive white flowers in early spring followed by red berries which turn blue when ripe. Flavor is similar to blueberries, and fruit is considered sub-acid. The newer dwarf Juneberry is low-growing and will be used a lot more in coming years as a hedge.

Rugosa Rose (*Rosa rugosa*)—develops into a very beautiful 4- to 5-foot flowering hedge that is loaded with crimson-red, long-lasting roses in clusters. Blooms resemble semi-double carnations, and then turn into the best part of all—rose hips, famous as a rich source of vitamin C. (Write to the *Organic Gardening* editorial offices in Emmaus, Pa., for free list of rose hip recipes.) Ideal for northern sections as it needs no winter protection.

Gumi-Cherry (*Elaeagnus multiflora*)—a relative of the Russian olive, this makes a fair hedge about 4 feet high. Plant at least 3 feet apart, as bush spreads. Berries have rather sharp flavor.

Elderberry (*Sambucus canadensis*)—produces large white flowers and clusters of berries. Purplish-black fruit ripens in August. Not recommended where space is limited.

Currant (*Ribes* varieties)—in shape, resembles forsythia, but far more important for the fruit you can harvest when used as a hedge.

Beach Plum (*Prunus maritima*)—Good possibility for hedge when placed about 3 feet apart and kept at 4 to 6 feet high. Native to East Coast sandy shores, many believe it worthy and capable to be grown in ordinary garden conditions inland.

Heavy fruit-producing varieties, like 'Autumn,' are now available, and the beach plum should be much more widely grown soon.

Dwarf Fruit Trees

If you have the space, you might plant a hedge of dwarf fruit trees. Overseas especially, dwarf apples, peaches, plums, pears, and cherries are being grown in a hedgerow system. Freeman Howlett, chairman of Ohio's Department of Horticulture, believes a hedge of dwarf apple trees to be most satisfactory.

John Dodge from Washington State also agrees on using dwarf apples (on Malling IX understocks) as a hedge form. He writes: "Trees can be planted from 4 to 8 feet apart and tied loosely to an 'oversize' grape trellis. Trees on number IX rootstocks are not well enough anchored to survive without some support. If planted as close together as 4 feet, trees should later be thinned to stand about 8 feet apart."

Malling IX stock will produce a tree about 8 feet tall at maturity. The attractive flowers of a dwarf tree hedge and the relative compactness give a fine ornamental effect.

Home gardeners here might also try an unusual pruning method with dwarf fruits which was developed in England. As reported by Rayner Brothers' W. F. Jeffers, this consists of rather drastic trimming each season so that the lowest branch is the longest and the upper branches are progressively shorter. This produces a pyramidal shape which allows good exposure of most of the tree to sunlight.

Besides dormant pruning, there's also much summer pruning which tends to decrease foliage and increase bud production. As practiced in England, this consists of cutting back lateral shoots to three leaves in midsummer when about half of normal growth has developed. Laterals that develop later are cut back to one leaf. With this intensive pruning, it is possible to start out with trees spaced only 3 feet apart.

Howard Rollins, Jr., of Virginia Poly-

technic Institute grows fruit trees, primarily apples and pears, on wires to serve as a screen.

He writes, "I plant the trees about 6 feet apart, placing a treated post between trees. Four wires are spaced down the row at about 18-inch intervals with my uppermost wire about 72 inches above the ground. Then I attempt to train my branches along these wires, tying them in place and removing those branches which might extend outward or perpendicular to the tree row. This procedure does require quite a bit of attention and care, but if you enjoy it, it is very rewarding."

Other fruit trees mentioned in our survey include figs and citrus for the southern states, and the dwarf Chinese peach, which grows about 5 feet tall and is hardy to 0 degrees.

Don't Forget the Nuts

Nut trees are usually too tall-growing for a good hedge, points out Laurence Manning, but there are exceptions like the hazelnut and filbert (*Corylus* species). These are low enough for an 8- to 12-foot hedge, but since they tend to irregular growth patterns, it will take work to keep them in hedge shape.

Almonds could be used if pruned like dwarf fruit trees. And there's the too-little-grown chinquapin (*Castanea pumila*), a bush-type nut tree. The nuts ripen earlier than the American chestnut.

"The chinquapin tastes like a sweet chestnut, and ours have never suffered from insects," says Sam Heatwole of Waynesboro, Virginia. Because these nuts like an acid soil, Heatwole top-dresses with cottonseed meal, mulches with sawdust, oak leaves, pine needles and bark.



"RED JADE" AT GENEVA COLLEGE

When the 'Red Jade' crab apple was developed by the late Dr. George M. Reed at the Brooklyn Botanic Garden, and patented, among the first trees to be distributed were two that were sent to Geneva College in Beaver Falls, Pennsylvania. Dr. Reed was a graduate of Geneva in the class of 1900. Today, 'Red Jade' is a landscape feature there. Shown here with one of the trees is the head gardener, Richard Michael.

INSECT BATTLE

U.S.D.A. entomologists are finding new approaches to pest control

Joan Lee Faust

SOME 10,000 species of insects in this country are considered pests, and of these several hundred affect the welfare of farmers, ranchers, foresters and home gardeners. The entomologists, chemists, biologists and agriculturists who are endeavoring to bring them under some form of control have an enormous task, and the ledgers are far from balanced. There seems to be a large debit opposite the credit entries.

Nonetheless, most insect pests are being conquered. One of the country's chief guardians is the United States Department of Agriculture's Agricultural Research Service in Beltsville, Maryland. A diligent staff is continually stockpiling an arsenal of knowledge to defend plant

and animal life from insect predators and it has chalked up some stunning victories.

Circumventing Offspring

One of the most significant is the control of the screwworm, a ubiquitous pest in the Southwest that has been a drain on livestock since pioneer days. By exposing male insects to radioactive cobalt, the males become sterile and when they are released in large numbers to mate with normal females, the progeny are reduced. By continuing releases over a period of several generations, the entire natural population can be wiped out. This pest was eliminated from the Southeastern States in this way.



Gypsy moths shown here (a male nearly twice natural size) are serious forest pests in the eastern U.S.A. In experiments of the U.S. Department of Agriculture, males are being trapped on sticky fly-paper inside cylinders baited with a sex attractant. While this type of bait gives promise, it is still on trial, therefore not yet available for general use.

U.S.D.A. Photos



Condensed from *The New York Times*, August 18, 1963.

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How the Individual Can Help In Reducing Insect Pests

WHILE responsibility for the development of control procedures belongs to research programs of the U. S. D. A. and of cooperating agencies and industry, each individual can play some part. Plant quarantine is looked upon as the first line of defense. There are more people traveling these days, trade has expanded and the ports of entry are busier than at any time in our history. The ports are closely guarded by the Plant Quarantine Division to stop invasion of insect pests. The individual traveler can aid his country greatly by refusing to smuggle any plant material or produce that might harbor insects. (Offenders are subject to fines.) Each foreign traveler should be familiar with the rules of entry for plant material.

In the back yard, the gardener can practice proper sanitation. Infected plants should be composted or burned. (Composting destroys many harmful organisms.) Egg cases of insect pests should be sought and destroyed whenever possible.

Millions of laboratory-raised, sterile male screwworms are being released daily in closely controlled areas in Texas with excellent results. The screwworm program has been so marked with success that it is spurring research on sterilization controls for fruit flies and many other food crop pests.

Luring Gypsy Moths

Another battle is being waged against the gypsy moth, a pest of forest trees. The female moth's sex attractant has been synthesized and is now used as a lure to trap the male moths. The traps are made of paper cups and hung on trees during July and August when the moths are in flight. The attractant is detected by the male moth's olfactory receptors located on the antennae. The male may fly as far as a quarter of a mile to find the trap. Widespread use is being made of these traps to see if they can significantly reduce the gypsy moth population. Sex lures are also being investigated for the control of European corn borer, the pink bollworm and the introduced pine sawfly.

Dr. Martin Jacobson, chemist in the Pesticide Chemicals Research Branch, is working on the isolation and synthesis of the insect sex attractants which lure the male insects to traps where they are

destroyed. The development of Gyplure, the attractant for the gypsy moth, was the breakthrough needed.

Changes Within a Decade

Progress along these lines has spread wide the doors which opened on the new approaches to insect control about 10 years ago. Dr. E. F. Knipling, director of the Entomology Research Division, pointed out that during the early part of the post-war years, two-thirds of the research was concentrated on the conventional approach to insect control, the broad spectrum insecticides. Success with these chemicals made them attractive and practical to use. But as more pesticides were developed, problems began to appear and side effects were detected. This stimulated investigation into new approaches.

"Today," said Dr. Knipling, "35 per cent of the program is directed to the alternate methods of pest control such as insect pathogens, biological parasites, sex attractants and male sterilization. The remaining 65 per cent is equally divided between chemical controls and fundamental research."

The "Target" Approach

Dr. Knipling described the new projects as "target" approaches, that is, the controls are directed to one specific in-



Cauliflower plant after attack by
cabbage looper

sect rather than a broad spectrum. These methods have one major advantage in that they reduce the population of a particular insect without affecting the environment. On the other hand, the development of these methods is slow and costly, involving many years of study and testing.

As Dr. Knipling sees it, the future holds a balance of "target" controls and chemical controls. "We will need insecticides for many years to come," he said, "to meet most of the insect problems. But in this field there is room for improvement. In addition there is space for expansion into the new approaches.

Although the specific method may not completely eradicate a particular insect, it will reduce the number significantly, prevent a population explosion and the need for heavy use of sprays." Dr. Knipling then went on to say, "It is not realistic to depend on the balance of nature (when predator and prey reach a balance). Too often damage has been done before an effective balance is reached and we need the supplementation of artificial controls."

Destroying Insects by Giving Them Diseases

In addition to attractants, the U.S.D.A. is studying insect pathogens and viruses. The development of milky spore disease for the control of Japanese beetle grubs first demonstrated the practicability of this approach. Disease spores applied to home lawns seep into the soil and destroy beetle grubs without affecting any other biological pattern in the soil.

Of recent interest in biological controls is the bacterium *Bacillus thuringiensis*. According to Dr. Arthur M. Heimpel, insect pathologist, this bacterium has been a known insect pathogen for many years and it kills more than 100 species. It is apparently restricted to the Lepidoptera (moths and butterflies) and Diptera (flies). It is harmless to warm-blooded animals and shows promise in the control of the caterpillars on leafy vegetables. Dr. Heimpel's research program is also delving into the virus diseases of many insects such as the corn-ear worm, cabbage looper and the tent caterpillar.



Experimental work in the U.S. Department of Agriculture has shown that many pestiferous insects can be controlled by parasitizing them with fatal viruses. *Left*, a cabbage looper arching its destructive way along a leaf of a cabbage relative. *Right*, the ruptured body of a cabbage looper which has succumbed to an experimentally administered virus. Infected remains can spread the disease to other loopers and thus save a crop.

LADY'S-SLIPPERS AS PRISONERS OF THE GARDEN

NATIVE orchids of eastern United States, particularly the lady's-slippers (*Cypripedium*), can be counted among our vanishing wild flowers. How can they be saved from the lumbering, farming and forest fires that have contributed to their disappearance? Mr. Ramsey, who has been studying and growing orchids for more than sixty years, recommends wildlife refuges for them. But with care they can also be cultivated, he says, and here he describes their needs and warns of the dangers to the plants when they are taken from the wild.

Carl T. Ramsey

TO combat the tragedy of our fast-vanishing wild orchids involves many factors that we have not been willing to face. The casualties are chiefly among the five eastern species of *Cypripedium*, and these have a wide geographic distribution. I have in mind the yellows (*C. pubescens* and *C. parviflorum*, or *C. calceolus parviflorum*), the Indian moccasin (*C. acaule*), the queen lady's-slipper (*C. reginae*), and the ramshead (*C. arcticum*).

The wildlife refuge is the logical answer; nevertheless, it may be worth while to assess the growing of the wild lady's-slipper as I have observed it over some sixty-odd years. Understanding the factors that are conducive to success may help us save the remnants found in highly specialized habitats.

In 1918 I knew of a score of stations in the Dorset Valley for the queen lady's-slipper. Today they have just about disappeared.

The ramshead—probably the rarest of our native lady's-slippers—is an acid-loving type, and usually occurs on the hummocks of arborvitae bogs. Many years ago I tried to remove it from its native haunt, and while it survived for some four or five years, it finally gave up the ghost.

The wild orchid sanctuary is the best

choice for preservation of the native species. Transplanting in most cases is apt to prove fatal. So many factors are involved—the chemistry of the soil and the nature of moisture in the soil, with a degree of temperature that has been maintained over ages of time. Furthermore, we have not only the factors of chemistry, such as lime and acid types of soil, but the specialized mycorrhiza or fungi found in orchid roots, a consideration that every specialist in orchid plant tissues has recognized for some time.

Moisture a Leading Factor

Everyone who grows wild orchids and has observed the prevailing conditions of the various species, knows the importance of moisture. *Cypripediums*, usually occurring in wooded bogs and moist hillsides, all thrive on rainwater. The danger of moles and shrews eating the crinkled roots during periods of drought is a constant menace, but where the wild fox prevails, these are kept in check. The ideal habitat, as I have observed over a half century, is distinctly a watery one, for this prevents rodents from getting to the roots and eating them. The plants may often be found with a foot or more of water covering the crowns all winter and during the latter

Condensed from the *American Orchid Society Bulletin*, June 1963.

part of May, and even to late June. So long as this prevails, no rodents can consume the roots.

Success in Vermont

We have several people in the Dorset Valley who have successfully transplanted the native *Cypripediums* because of their intimate knowledge of natural-growth factors. One crown of *C. parviflorum* came from the local Aeolus ridge in 1918—some fifty in the crown. One half was left in the wild station and the other half I took to my mother-in-law's front lawn, directly under the eaves of the roof leader, where the frequent rains maintained constant moisture. I selected this spot because of its prevailing shade—provided by a huge sugar maple some fifty feet from the house. I removed half of this to our "Swamp-acres" area in 1934 and made two groups. Last year the original had increased to twenty-two stems, several of these having had two blooms. I found two stems with seed capsules, showing that bees had been active on this crown. The number of the "Swampacres" crowns had doubled and quite a few were pollinated, showing that there had been constant increases since the crown was removed from the original station. *Cypripedium reginae* has a similar record in one case, having been relocated in 1927. Meanwhile this group has flourished. The question of rainwater is again involved. The crown is watered with every new rain, for the spout from the leader is located near this crown and in partial shade.

A lady in the village started with a small group in 1930 and today she has between seventy and eighty in the crown. A dressing of leaf mold and a blanket of autumn leaves is the winter covering that revitalizes them for the following spring's growth. When the spot becomes dry she lets the hose lightly flow all night over the crown.

A friend in Manchester had a rather remarkable crown of an albino *Cypripedium reginae* which he had found while trout fishing. He had been successful in growing it on the north side of a wood-



Gottsch-Schleisner

The queen lady's-slipper (*Cypripedium reginae*) will flourish in a garden if given shade and abundant moisture.

house for a half dozen years, but didn't like the unsightly building. He consulted me before he tore it down. I warned him that it would be fatal—and so it proved, for the excess sunlight was too much for the mycorrhiza.

Hazards to be Overcome

The questionable elixir of orchid roots, in use as a patent medicine for nerves, has also added to the decimation of the lady's-slipper. One youth made up his mind to combat the traffic by removing as many plants of *C. reginae* as he could find to his garden on the north side of his brick house. The planting was successful, and there were 500 or 600 in his bed. But a year of drought came and the whole bed vanished. It is likely that field mice and shrews also contributed to the demise of the plants.

If domestic fowls are kept in the vicinity, the transplanted beds should be carefully fenced off because the tender shoots are delectable in spring.

These are a few of the initial dangers the orchid digger hardly considers in his passionate quest.

WHY TRY TO RAISE FRUIT TREES FROM SEED?

There is not a chance in a million of producing anything edible

IF seeds of apples or other familiar cultivated fruits are sown, the seedlings that develop will most likely be degenerate-fruited plants suitable only as root-stock for grafting. It is by grafting that the named varieties of fruits are perpetuated. Only by some such vegetative method of propagation can they retain the original genetic constitution that assures them their distinctive flavor, color and other characteristics. Seedlings contain the genes of so many ancestors that there is at best an infinitesimal chance of their fruits' being pleasantly edible. The original wild apples, for instance, are believed to have been small, hard, sour, and perhaps even bitter. Some of these traits are almost certain to reappear in apples that are raised from seed.

George Abraham

WHAT happens if you plant apple seeds? Do you get edible fruit? Your chances for it are slim and the home gardener would be foolish to nurse a tree started from a seed. The seedling would probably grow into "common" fruit, unless you do what nurserymen do: Bud or graft cultivated fruit on the wild seedling.

I don't mean to say that it is not possible to get good fruit from trees started through seeds. Most of our popular varieties of today were discovered as chance seedling trees started from millions of seed scattered by birds, people, and animals all over.

For example, the Northern Spy was first found as a chance seedling in East Bloomfield, New York, about 1800, and the Red Delicious variety was discovered as a chance seedling in Peru, Iowa. Rome Beauty was found in Ohio, and Golden Delicious in Porter, West Virginia. The McIntosh was found growing in brush land in Ontario, Canada, in 1796. John McIntosh was clearing some wild land when he discovered what is now known as the McIntosh apple.

Another method in which new varieties are obtained is through controlled breeding. This is a long-range project since it takes so long for a tree to be evaluated. The Cortland variety, introduced by the New York Agricultural Experiment Station in 1915, has been planted by growers more than any of the other varieties originated through cross pollination. Cortland is a cross between a Ben Davis and the McIntosh.

Another method of obtaining new varieties is by "mutation," or a sudden "sporting." A red apple tree may suddenly produce a limb with yellow apples. In 1921, a Red Delicious apple tree in Monroeville, New Jersey, produced a fruit with better color and a leading nursery purchased it for a reported \$10,000, naming the new fruit Starking Delicious. There are at least 35 other named varieties that have occurred from Red Delicious mutations.

Growing apples from seed can be a good hobby but if you start it, be sure someone in the next generation will be on hand to evaluate your work. It's not a good overnight project.

Reprinted from the author's syndicated gardening column "Down to Earth"
November 15, 1963

HYBRID CHESTNUT THRIVING IN EAST

*Scions being made available represent culmination
of research by Arthur Harmount Graves*

John C. Devlin

THE lordly American chestnut, once one of the glories of lawn and forest, is staging a strong comeback as a hybrid.

Scientists at the Connecticut Agricultural Experiment Station in New Haven have nine "kissing cousin relations" for the chestnut, once king of the hardwoods from Maine south to the Carolinas and west to Illinois.

The tree, whose usefulness was said to have surpassed the oak, maple and hickory, was virtually blotted off the American landscape by what may have been one of the greatest natural scourges ever to hit the American botanical scene.

The plague, a fungus apparently introduced on nursery stock imported from the Orient for Long Island estates, was first discovered on an American chestnut at the Bronx Zoo in 1904.

Today, virtually the only known American chestnuts that still live as full-grown trees are those isolated ones, transplanted long ago beyond the periphery of the now-blighted natural growing area.

Sprouts from living American chestnut roots still make their way up to 25 or 35 feet, and sometimes bear chestnuts, only to be cut down by the blight.

Work of Dr. Graves

The present hybrids, crosses of the American chestnut with species of Chinese and Japanese chestnuts, are the result of experiments by the late Dr. Arthur H. Graves of the Brooklyn Botanic Garden, and Dr. Richard A. Jaynes of the Connecticut experiment station.

Their work was done with the coop-

eration of Federal scientists who had the bitter experience in the early 1950's of seeing their handsome chestnuts smashed by bulldozers. The trees had been grown on rented land in Maryland and, when the lease ran out, the landowner proved to be uninterested in their research.

The fundamental research in Connecticut is being done on two state-owned experimental farms in Mount Carmel and Sleeping Giant Mountain, north of New Haven. One farm was donated by Dr. Graves, who lived in retirement in nearby Wallingford and conducted his chestnut experiments on the grounds.

Today about 1,000 chestnut trees, some thriving and some dying, grow on the lovely rolling Connecticut acres under the scrutiny of Dr. Jaynes and his staff.

Nine Hybrids Available

Out of the burgeoning forest, made up of seedlings of a few inches to trees more than 40 feet tall, Dr. Jaynes has selected nine hybrids from various species and other hybrids. These he regards as the best of all experiments conducted to date.

Some of the hybrids grow faster than others, some have bigger or sweeter nuts, some a more handsome conical shape, some have burrs that produce nuts even before the first frost.

Like horse and dog breeders, Dr. Jaynes has produced several trees for special purposes: some for forests, some for home shade trees and some for

(Concluded opposite)

From *The New York Times*, September 29, 1963

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"TREE FARM" SIGNS

*They signify good forest practices
and assurance of tree crops for the future*

THE green sign you see by the side of the road is a badge of good forest management. There are some 26,000 across the nation. The owner of the woodland has been honored by the American Tree Farm System for practicing good forestry. This program is sponsored by the American Forest Products Industries, Inc., 1816 N Street, N.W., Washington 6, D.C.

To win this honor, the tree farmer has to learn the latest forestry techniques, then he has to apply them to his woods. Now he is growing trees as a crop and protecting them against fire, insects and diseases. He is harvesting his trees in ways that assure a continuous crop. He is planting his idle acre to trees.

By doing these things he is assuring America of a never-ending flow of forest goods and services. We use nearly 6,000 products from the forest. But there are many other values on Tree Farms. They help protect our watersheds, guard against soil erosion, provide habitat and food for wildlife, and provide outdoor recreation opportunities.

Growing trees the "tree farm way" means using the forest without destroying it. By the year 2000 we will need nearly twice as much wood as we are now using



and almost three times as much outdoor recreation area.

The typical tree farmer is helping to meet our present and future needs forestwise. He is playing a significant part in "bringing back the woods."

Condensed from *The Connecticut Motorist*, September, 1963.



(Continued from opposite page)
commercial nut uses, such as ground nuts for chicken and turkey stuffing.

Dr. Jaynes now is ready to share the chestnut discoveries. He is prepared to ship one-foot-long sections of his successful hybrid scions to people with blight-resistant stock of Oriental chestnuts.

The priorities are: scientific agencies, Connecticut nurserymen, other Connecticut citizens, out-of-state commercial growers, out-of-state amateurs.

Requests should be sent to the Connecticut Agricultural Experiment Station, P.O. Box 1106, New Haven, Conn. Include \$1 for handling charges.

GARDENER'S MISCELLANY

PETROLEUM MULCH DEVELOPED

New product shows promise for crops, gardens and lawns

GARDENERS and farmers sometimes spread a mulch of straw, leaves, sawdust, paper, dead moss or a similar substance to protect the roots of young plants from cold and drought. Now the firm Esso Research has developed a mulch of inexpensive petroleum resins that does the job far more effectively than traditional materials, producing large increases in crop yields.

The substance performs four functions. Because it is dark it absorbs heat from the sun, warming the soil by as much as 20 degrees Fahrenheit and speeding germination. It reduces evaporation of water from the soil. It holds the soil, thereby decreasing erosion, and it prevents water and other agents from dispersing mineral and chemical fertility factors in the soil.

Esso has been testing the mulch in various parts of the world for the past three years. After a field is planted with a row crop the emulsion is sprayed on in bands from three to ten inches wide. It forms a thin, continuous film that clings but does not penetrate deeply and that lasts from four to ten weeks.

The new mulch has proved particularly effective in arid climates. The material apparently does no harm to the soil. One field was covered with a 20-year supply of mulch, then plowed and planted; it produced a normal crop.

Esso's Own Report

According to *The Lamp*, a publication of the Standard Oil Company (New Jersey), the application of the petroleum emulsion to a seedbed, in strips from

three to eight inches wide, is easy and usually quite inexpensive. On small plots, the liquid can be sprayed on by hand. On commercial farms, a simple spraying device can be attached to the type of mechanical seed planter most farmers use.

The first experiments with the new mulch on seedbeds were made by Esso Research on small plots at Linden, New Jersey, in 1959. Seedlings of various kinds grew without difficulty right through the thin strips coated with the emulsion. Furthermore, the emulsion clung tightly to the soil during the growing season, absorbing heat from the sun and preventing the escape of moisture. After about three months, the particles of mulch began to mingle with the soil, a process hastened by cultivation. Eventually, the particles are oxidized by bacteria and act as a soil conditioner by making the ground more porous.

Further tests are under way on a wide variety of crops, both in this country and abroad. And, as with all new preparations to be applied to food crops, the properties of this mulch are being reviewed by the U. S. Food and Drug Administration.

Active marketing will not begin until after these various commercial demonstrations and tests are completed.

Meanwhile, experiments on range grass are being continued, and work with lawn grasses is also in progress to find out if the new mulch can help homeowners with steep banks or sloping lawns. Wherever it is used, the mulch is of value in soil conservation, slowing down or preventing erosion by both wind and water.

Condensed in part from *Scientific American*, April 1963. Also see *The Lamp*, Summer 1962.

CRABGRASS ON WAY OUT

Also certain other weeds, and insects too

AFTER widespread testing in many areas of the United States where crabgrass is a serious problem in lawns, the Dow Chemical Company began marketing the pre-emergent crabgrass killer known as Zytron. Since it was placed on sale in the Northeast in 1961, many homeowners have discovered its effectiveness. At the Brooklyn Botanic Garden, two years of trial in two special gardens have shown it to give complete control of this common pest of lawns. Wherever experience has shown Zytron to give unsatisfactory results, the cause can usually be attributed to lack of uniform application, incorrect rate of application, wrong timing (after emergence of crabgrass), or too dry conditions after treatment.

The chemical, known technically as O-(2,4-dichlorophenyl) O-methyl isopropylphosphoramidothioate, is a selective root toxicant. It is available chiefly as a dry granular material which is easily applied with an ordinary fertilizer spreader. Most established lawns, such as those of Merion Kentucky bluegrass, Bermuda grass, St. Augustine grass and Zoysia, are not injured by the granular form, if recommended rates are not exceeded. Zytron has the further advantage of not being toxic to most established garden plants, although injury to iris, dichondra, and white clover has been reported.

In addition to crabgrass control, Zytron is now known to be effective on nimble-

weed and knotweed (*Polygonum*) in lawns, also green and yellow foxtails (*Setaria*), crowfoot grass (*Dactyloctenium aegyptium*), stinkgrass (*Eragrostis ciliaris*), barnyard grass (*Echinochloa crusgalli*), goosegrass (*Eleusine indica*), wood sorrel (*Oxalis stricta*), spurge (*Euphorbia*), purslane (*Portulaca oleracea*), pigweed (*Amaranthus retroflexus*), smooth or common chickweed (*Stellaria media*), mustard (*Brassica*) and lamb's-quarters (*Chenopodium album*). Spring applications at the standard rate are recommended (see manufacturer's directions on package: 20 pounds of the 4.4% granular formulation per 2500 square feet).

It should be understood that Zytron is not a general lawn weed killer and will, therefore, not control dandelion, dock, plantain, quackgrass, Canada thistle or established tall fescue.

Since Zytron will destroy many grasses in the seedling stage, it is not advisable to reseed a lawn immediately or soon after treatment. Similarly, newly seeded lawns should not be treated.

While not primarily an insecticide, this compound is known to reduce the number of anthills, and is reported to provide some degree of grub eradication. In southern lawns, chinch bugs may be kept under control with repeat applications about every 60 days.



CAR JACK RAISES TREE

A HALF-uprooted apple tree, with many branches broken by its fall, has responded to four months of patient work by its North Carolina owner, C. L. Zeigler. A car jack was used to bring the tree to an erect position.

Starting in June, Mr. Zeigler began applying his automobile jack, first protecting the tree with soft material. After

each heavy rain he lifted the tree a little more. By October it was standing erect. He then covered the exposed roots with soil, and braced the tree with three guy wires run through rubber hose around the trunk.

The following April it was in bloom. Adapted from Algine Neely, in the *Winston-Salem* (N. C.) *Journal and Sentinel*, April 14, 1963

GIBBERELLIN ON CAMELLIA BUDS OPENS FLOWERS FASTER

Mary Noble

CAMELLIA growers who applied gibberellin to buds in September or early October were picking beautiful blossoms by mid-November in Jacksonville, Florida. The flowers were larger and they lasted longer. They opened while other buds on the same plants were tight and green and not expected to mature until December or January. The process is colloquially known as "gibbing."

To cause a camellia bud to develop with unusual rapidity, only a drop of the gibberellin acid solution is needed. [Prepare it in a two-ounce brown glass bottle with a tight screw cap. To one ounce of distilled or rain water, add $\frac{1}{2}$ gram (approximately one-twelfth of a teaspoon) 85 per cent gibberellin acid powder and 12 drops of household ammonia—not the sudsy type. Shake to dissolve the powder, and store in refrigerator.] This may be applied by breaking off the adjoining growth bud and dropping the solution on the stub, placing it between the bud and the nearest leaf, or in a cut a few inches below the bud on the stem.

Approximately six to eight weeks later



Lew Bush

Gibberellin-treated bud of camellia has come into full bloom on November 4, instead of in December or January. Note the normal, untreated bud in the circle.

the treated bud will be an open flower, while others on the same plant are progressing on their regular schedule.

Only a few buds on a plant should be treated at a time, not all at once. This makes for a succession of bloom. It also opens a few flowers before the coldest weather, whereas later buds on the same plant may be frozen.

Condensed from *The Florida Times-Union*, Jacksonville, Florida, November 17, 1963.

AUTHOR'S NOTE: At the American Camellia Society meeting November 23, 1963, the Governing Board adopted new rules creating a third class of bloom to be called "Chemically Treated Blooms." This term applies to flowers treated with gibberellin acid or any of its derivatives or similar type chemicals.

While blooms of any type may compete with each other in cooperative shows, regardless of treatment or growing conditions, the ACS rules now specify that "No such treated bloom shall be disqualified from entry in any American Camellia Society cooperative show."

The new rules apply to all shows scheduled January 1, 1964, and thereafter, and the society's Rules and Regulations booklet is being reprinted to conform to the changes brought on by the popular use of "gibbed" blooms.



Noble

Method of applying gibberellin solution from a medicine dropper to the base of the bud.

RAIN-RESISTANT ROSES

Fred Fairbrother

FEW things in the garden are more distressing than a bed of potentially lovely roses ruined by wet weather. Yet there are varieties which are highly resistant to damage by rain, amongst both the hybrid teas and the floribundas.

Among the hybrid teas are:

Ena Harkness, bright crimson
Peace and Grand'mère Jenny, yellow edged with pink
Sutter's Gold, orange-yellow
Spek's Yellow (Golden Scepter) and **McGredy's Yellow**, pure yellow
Rose Ganjard, deep rose and white bicolor
Ballet and **Pink Favorite**, pink
Virgo, white

The floribundas, generally speaking, are less affected by wet weather than are the hybrid teas. The following will not fail you, even in the wettest of weather:

Red Favorite, deep crimson scarlet
Moulin Rouge, lighter, brighter red
Paprika, bright Turkey-red
Olala, scarlet crimson
Queen Elizabeth, clear pink
Poulsen's Supreme, rose-pink
Allgold, yellow
Iceberg, white
Masquerade, bright yellow to dark red

If the summer provides more than usual sunshine hours, all these wet-weather varieties are equally happy.

Condensed from *Popular Gardening*, London, July 27, 1963



(Concluded from page 25)

four-lane freeways and to make plans to drive four-lane freeways through some of the groves. "It is three seconds before midnight," says Dr. Edgar Wayburn, President of the Sierra Club, which is supporting and augmenting the Save the Redwoods League program.

For the redwoods are also a spiritual resource. No one can associate with them

on equal terms. They belong to a self-contained world that is silent, detached, lofty and overwhelming. Last year a professional German forester visited the redwood parks. When he was deep in the Humboldt Forest in the presence of some of the finest redwoods he removed his hat, bowed his head and said, "Thank you, Lord."

Amen.

REDWOODS

in Humboldt State Redwood Park. Near center, Founders' Tree, world's tallest, measuring 364 feet, with trunk circumference of 47 feet.



THE REWARD OF WATCHING TREES FOR EARLY BLOOM

Elisabeth Keiper

EARLY spring developments on most woody plants are not spectacular. You have to look sharply or you will miss them.

Swelling buds and the breaking of blossoms on the elms slowly transform the winter-time network of gray twigs overhead into a tawny lacework that comes alive in the yellowing late afternoon sunshine. But who takes time to pause, look up and see an elm in bloom?

When the gas and electric company took some "yardage" out of my white birch tree (its altitude was interfering

with the service lines), I carefully gathered an armful of the fallen branches and carried them indoors. I selected the ones that were nicely tipped with dormant male catkins. Since then I have had a closeup view of the flowering of the white birch. This is a performance that has taken place so far up that previously it was only a pattern against the sky.

Catkins may be seen early in the season also on the poplars, the alders and the filberts. Willows have catkins, too, held more or less erect, rather than drooping in tassel shape. Everyone knows the pussies of the pussy willow, though probably few persons take note of them as flowers.

A little later will come the flowering of the oak trees, largely unnoticed. About the time when the first new leaves begin to show, the oaks hang out myriad clusters of catkins. These are the pollen-bearing flowers. The female flowers are in small inconspicuous clusters on the same tree.

None of these is known as a "flowering tree." But all trees have flowers and, if you only pay them a little attention, you will find some of the least dramatic the most interesting.

Condensed from the *Times-Union*, Rochester, New York, April 12, 1963.



DOUBLE ROOF

For greenhouse in hot climate

A FIBER-glass roof constructed about two feet above the original roof of his 11- by 14-foot home greenhouse has proved practical for Ernest W. Giese of San Antonio, Texas. Writing in *The Glo-inian* for March-April 1963, Mr. Giese says: "This helps with the shading problem and reduces intense sunlight. The fiber-glass is milk-white and produces a cool white shade. The double roof reduces the greenhouse temperature by about 15 degrees in summer."



Keiper

Catkins of white birch, forced into early bloom by bringing them indoors, surrounded by the evergreen foliage of boxwood.

PATRICK'S THORN, A WINTER-BLOOMING BLACKTHORN

A NEWSPAPER feature called "The Face of Faith," in one of its 1963 items, told about Patrick's thorn, which flowers in winter when other such trees are bare. According to legend, one winter night Saint Patrick was on his way to Tours, France, to visit his cousin Saint Martin, the bishop there. Growing weary, he lay down to rest beneath a thorn tree. (Though legend may call it a hawthorn, evidence points to a blackthorn.) The tree shook the snow from its branches and burst into bloom, and to this day it still flowers in winter outside the village, which was later named Saint Patrice in recognition of the miracle.

An inquiry sent to Dr. T. J. Walsh, Director of the National Botanic Gardens at Glasnevin, Dublin, Ireland, brings in reply a botanical reference to "Patrick's thorn." It comes from the seven-volume work *The Trees of Great Britain and Ireland* by H. J. Elwes and Augustine Henry (Edinburgh, 1906-1913). Footnote 3 under Glastonbury thorn (*Crataegus monogyna* var. *praecox*), which flowers at Christmas-time and supports

a similar legend, with Joseph of Arimathea involved, says of Patrick's thorn:

At the Chateau du Chabrol, St. Patrice, on the Loire, midway between Saumur and Tours, there is a large blackthorn, called *l'épine miraculeuse*, which flowers every year in the last week in December, even in the severest seasons. The legend is that St. Patrick, while on his way to Tours in A.D. 395, reposed one night in winter under the shade of this tree, which burst forth into flowers and leaves to shield him from the cold. The tree did not appear to be very old in 1850, but is now of considerable size, judging from a photograph sent me by M. Hickel. This curious variety, which may be named *Prunus spinosa*, var. *praecox*, does not seem ever to have been propagated.

The holiday issue of *Country Beautiful* magazine* (December 1962-January 1963) contains a discussion of Joseph of Arimathea's wanderings and the possibility of his having been in Glastonbury. The article, with illustrations by Clare Leighton, is from *The Flowering Hawthorn* by Hugh Ross Williamson. (Hawthorn Books, Inc., 1962).

*15330 Watertown Plank Road, Elm Grove, Wisconsin (editorial office); 1255 Portland Place, Boulder, Colorado (subscription office).



23,900 SPECIES OF CULTIVATED PLANTS

When *Hortus* was originally published in 1930, 2,519 genera and 12,659 species were listed. In 1935 Liberty Hyde Bailey published a supplement in which 2,722 genera and 15,552 species were included. These represent increases of 8 per cent in genera and 23 per cent in species over the first edition. By 1941 when *Hortus Second* appeared, the totals had gone up to 2,961 genera and 18,447

species, respective increases of 9 and 18 per cent. As of 1960, which is the cut-off date for *Hortus Third*, it is estimated that another 574 genera and 5,455 species have been added, increases of 19 and 30 per cent. This means that today we are dealing with about 3,555 genera and perhaps 23,900 names of species, nearly 8 per cent of all the kinds of flowering plants known, according to estimates.

From an address by Harold E. Moore, Jr., Director of The L. H. Bailey Hortorium at Cornell University, before the American Gloxinia Society's Eighth Annual Convention at Ithaca, New York, July 5, 1963. The complete address on "What the Bailey Hortorium Means to the House Plant Grower" appears in *The Gloxinian* for July-August 1963.

GARDEN CART, HOME-MADE, SAVES MANY TRIPS

*Flats, potted plants, shrubs, trees, fertilizer
compost, soil, tools, hose, catalogs can be carried*

AN all-purpose, home-made cart for garden use is described by J. E. Tillotson in *Flower and Garden* for December 1963. Basically, it is a box with one end on wheels and with pockets, shelves and other holders for equipment. While it can be made of any kind of wood, the one illustrated is of redwood and marine plywood.

With shelves in place, potted plants or flats can be transported. With shelves removed, the same space can be used for woody plants or for carrying sacks of

fertilizer and other supplies. With plywood fitted across the front, soil, compost, trash and other loose materials can be carted about. Space is also provided for hose, hand sprayer and tools, as well as for labels, notebooks, and catalogs. The shelves themselves, when not in use, fit into one of the pockets.

Complete specifications are given by the author for his "back-and-foot-saver" cart, which, he says, saves many trips when gardening.



Philpott

Home-made garden cart. Shelves at back can be removed to make room for bags of fertilizer. Notebooks and/or catalogs can be kept in pockets on front.

ORGANIC MATTER AND WETTABILITY OF SOILS

*If water penetrates with difficulty,
here are some suggestions*

O. R. Lunt, R. H. Sciaroni, W. Enomoto

GROWERS of house plants often find that their soil does not absorb moisture readily. Their problem may be related to the one described here, and its correction may be effected by the same methods.

GREENHOUSE flower growers have consistently added substantial amounts of coarse organic matter to soil mixes to aid the movement of water by making the soil more porous, improving drainage, lowering the weight of the soil per unit volume, reducing compactibility and increasing the water-holding capacity. However, prolonged use of this practice has been observed to seriously decrease wettability in some cases. Laboratory tests have confirmed these observations.

Samples of soils found increasingly difficult to wet at the Enomoto and Co. glasshouses, San Mateo County, were submitted to the Department of Irrigation and Soil Science, University of California, Los Angeles.

All soil samples except for one, of U. C. (University of California) Mix, came originally from the field soil (Dublin clay) located on the property. Sphagnum peat or animal manures had been regularly used on some of these benches dating as far back as 1933. The organic matter on a dry weight basis varied from a low of 7% by weight to a high of 16% for the bench samples, while the field soil was 4% organic matter. The organic matter content of the U. C. Mix sample was 4.2%.

All of the soils tested in the laboratory except the U. C. Mix displayed a tendency to repel water almost to the same degree as would a waxed paper. The U. C. Mix was only moderately unwettable, perhaps because of its shorter history and the large percentage of sand present.

At this time, there is no practical method known for preventing the development of non-wettability in soils. But the following practices may be helpful in coping with this problem:

- (1) The use of commercial wetting agents.
- (2) Watering the soil in two stages.
- (3) Mulching to break up crusts that form on the soil surface.
- (4) Replacing the old soil with new soil.

Condensed from *Under Glass*, July-August, 1963. Originally published in *California Agriculture*, University of California, Los Angeles, California.



DUMB-CANE POISONING

DUMB-cane (*Dieffenbachia seguine*), sometimes grown as a house plant, is capable of producing severe poisoning if any portion of the plant is taken into the mouth, even without being swallowed.* The *Journal of the American Medical Association* for June 29, 1963, reports a case in which pain and swelling of the tongue, palate and adjacent glands as well as the face continued for about ten days. A caustic type of burn was also present.

*EDITOR'S NOTE: Other species of *Dieffenbachia* also cause temporary paralysis of the tongue, and may produce more serious symptoms.

THE SIZE OF APPLES

A lesson in the importance of thinning fruits. At the top, only one apple was left to develop on a short branch, or "spur." *Center*, two apples were left on the same spur. *Bottom*, three apples were allowed to grow on a single spur at the tip of the branch—their total size is scarcely more than that of one of the single apples at the top.



FAKE FLOWERS

A rose by any other name may smell as sweet, but increasingly Americans have come to prefer a rose that doesn't smell at all—and that really isn't a rose but a reasonable facsimile thereof. The artificial flower business has blossomed into a \$120-million retail industry. Since artificial flowers are made almost entirely by hand, Hong Kong, where coolie wages still prevail, now has almost a monopoly on their production. Founded in 1955, the artificial flower business in Hong Kong today employs about 100,000 skilled workers, according to Revlon subsidiary Zunino Altman, Inc., the world's largest manufacturer of roses-that-aren't-roses.

Reprinted from *Forbes* magazine, January 15, 1964

PLANT PATENTS

Since the Plant Patent Act was established in 1930, patents have been issued on 2,250 distinctive new varieties of plants. More than 1,000 of these are roses, but so many other types of plants have been included that the original four categories of Roses, Other Flowering Plants, Fruiting Plants (edible fruits) and Miscellaneous Plants were increased this year to 89 divisions in nine major categories. These are Roses, Nuts, Fruits, Conifers, Broadleaf Trees, Shrubs or Vines, Herbaceous Flowering Plants, Herbaceous Ornamental Foliage Plants, and Miscellaneous.

When a plant patent is granted by the Federal Government, the originator (or one to whom he assigns his rights) assumes the role of "inventor." All others are excluded from asexually reproducing or selling the patented variety for 17 years.



PLASTIC TUBING



George J. Ball Company

Slipping a sleeve of polyethylene plastic around a flat in which seeds have been sown protects against drying and may thus save the life of the plants. Seeds are sown in the usual manner in pasteurized soil or some sterile medium, watered thoroughly, then covered with plastic, tucked under at each end. A second watering is seldom needed. As soon as seeds have germinated, plastic is removed, as shown above. The sleeve, called "Plasticover," comes as a tubing in rolls of 100 feet 20 inches wide.

STEPPING-STONES WITH LEAF IMPRINTS — *an idea*

How to make them

STEP 1 (not shown): Bend a 3-inch-wide strip of hardboard to make a circular form; overlap ends and nail together. Excavate area for stone 6 inches deep. Place 3-inch layer of sand under form. Pour concrete into form, press firmly in place, and trowel the surface smooth.

Step 2 (at right): Press the back, heavily veined sides of leaves into the moist concrete. Cover with plastic until concrete has set.

Condensed from *Better Homes and Gardens*, September 1963. The Meredith Publishing Company, Des Moines, Iowa.



SOILLESS MIX FOR SEEDS, PLANTS

FROM Cornell University comes a tested formula for starting seeds and plants and even, with the aid of fertilizer, for growing plants for more extended periods. It contains no soil. Damping-off and other diseases are therefore unlikely to attack. In small quantities, the medium can be made as follows:

INGREDIENTS	TO MAKE	
	One peck	One cu. yd.
vermiculite (No. 2 Terralite)	4 qts.	11 bushels
shredded peat moss	4 qts.	11 bushels
20% superphosphate (powdered)	1 tbs.	2½ pounds
ground limestone	2½ tbs.	10 pounds
<i>Use one but not both:</i>		
33% (fertilizer grade) ammonium nitrate	1½ tbs.	3 pounds
or 5-10-5 fertilizer	4 tbs.	12 pounds

(Continued from pages 30 and 31)
Another way to extend a garden into the vertical dimension: bracket-supported geraniums on a board fence.

Taloumis



Mix the ingredients on a table or clean floor. Before setting plants or sowing seed, put the medium in the pot or flat and place the container in water and soak thoroughly, the water coming up through the bottom of the container. Let drain for 30 minutes and then soak again. Then sow seed or plant; water only as needed.

If used for indoor plants which will be grown for a long period, supplemental feeding with a water soluble fertilizer is required. In small pots (less than 3 inches) the medium tends to dry out quickly, so it is better suited to larger containers.

CORRECTION IN NAME OF CULTIVATED FERN

UNDER the title of "Common vs. Technical Names," Dr. Edgar T. Wherry has contributed a note to the *American Fern Journal* for April-June 1963 in which he points to an error in the scientific name of a fern mentioned in *Plants & Gardens* for Spring 1962, the Handbook on "Gardening with Native Plants." The Botanic Garden's Editorial Committee commends Dr. Wherry for catching this error and for going directly to the author about it.—Ed.

MANY amateurs favor the use of "common" or colloquial names for ferns, holding that technical ones are too difficult to remember; and what difference does it make anyway? Sometimes it can.

In the Brooklyn Botanic Garden's handbook on "Gardening with Native Plants" (p. 61), Miss Caroline Dormon, an outstanding southern wildflower gardener, noted that she was successfully growing "*Polystichum lonchitis*." As that is a northern and subarctic limestone ledge plant, that it could survive in rich soil in the mild climate of Louisiana seemed doubtful, so I wrote my friend about it.

It turned out that the plant referred to

was known thereabouts as Holly Fern, and "the books" gave the technical name of that as *Polystichum lonchitis*. However, on looking into the matter further, Miss Dormon found that what she had was actually *Cyrtomium falcatum*, a warm-climate species [from Asia].

If uninformed lowland fern gardeners proceed to purchase the northern plant from dealers, they are going to be disappointed at its failure to thrive. Only if they are willing to learn the technical names and native haunts of the several so-called "Holly Ferns" will they be able to order plants suitable for their environment intelligently.—E.T.W.



Leucospermum nutans, a member of the Protea Family, photographed in the National Botanic Garden at Kirstenbosch, South Africa. The proteas are the subject of an article by Elizabeth Scholtz in *Natural History* magazine for May 1963.



WORTH READING

A Supplementary List of Significant Articles, Bulletins and Books Published During 1963

ARTICLES AND BULLETINS

Rural Recreation Enterprises for Profit: An Aid to Rural Areas Development. Agriculture Information Bulletin No. 277. *Rural Recreation: New Opportunities on Private Land.* Miscellaneous Publication No. 930, U. S. Department of Agriculture. Numerous ways proposed for using surplus acreage to give the public more convenient opportunities for outdoor activities, with profit to the landowner. Water sports, winter sports, horseback riding, camping, hiking, picnicking are among the suggestions. 20 cents each from Superintendent of Documents, Washington, D. C., 10402.

Connecticut Hybrid Chestnuts and Their Culture. Richard A. Jaynes and Arthur H. Graves. Bulletin 657, Agricultural Experiment Station, New Haven, Connecticut. Descriptions of nine successful hybrids and their uses, cultural directions, propagation techniques, and the outlook for the future.

Lawn Weeds: Identification and Control. J. D. Butler and F. W. Slife. Circular 873, Cooperative Extension Service, College of Agriculture, Urbana, Illinois. More than 40 weeds described and control measures given. Keys, drawings and photographs aid in the identification of common kinds.

Some Results of Producing Gloxinias under Fluorescent Light Sources. J. W. Boodley and F. F. Horton. *The Gloxinian*, September-October. Records with eight different set-ups, three distances for each (8, 16, and 24 inches), showed that a combination of Mark VI and Gro-Lux I lights 8 inches above the soil gave best results.

The Green Grass will Grow Wherever You Live. *American Home*, March. Directions for success with lawns given by contributing editors from each of six major sections of the United States.

The Tulip and the Netherlands. F. A. Stafleu. *Lasca Leaves*, Spring. California Arboretum Foundation, Box 688, Arcadia, California. From the introduction of the first bulbs in the sixteenth century to the exploration and breeding of the mid-twentieth century, the story of the tulip is shown to be closely linked with the history of

Holland and of Western Europe. (The article also appears in the May-June number of the *Garden Journal* of The New York Botanical Garden, Bronx 58, New York.)

Rooibos Tea, South African Contribution to World Beverages. Ralph Holt Cheney and Elizabeth Scholtz. *Economic Botany*, July-September. Stechert-Hafner Company, 31 East Tenth Street, New York 3, New York. South Africa's "national drink," which is gaining increased use abroad, comes from *Aspalanthus contaminatus*, a shrub of the Pea Family. Tests show it to be high in vitamin C and low in tannin.

Bromeliads. Walter Singer. *Garden Journal* of The New York Botanical Garden, January-February, March-April, May-June, July-August. Description, historical background, culture, propagation, breeding, and a wide selection of species and varieties are presented in this series of well illustrated articles.

Trial Plot for Street Trees. Donald Wyman. *Arnoldia*, January 18. Arnold Arboretum, Jamaica Plain, Massachusetts, 02138. Booklet lists 109 species and varieties under trial at Weston, Massachusetts. All are small ornamentals suitable for home grounds or street.

College Natural Areas as Research and Teaching Facilities. Edited by James B. Ross. Research Publication No. 1, The Nature Conservancy, 2039 K Street, N.W., Washington, D. C. Acquisition, establishment, management, use and preservation of natural areas as adjuncts to college programs are discussed in these proceedings of a Conservancy symposium. \$1.

Agricultural Chemicals—What They Are/How They Are Used. Manufacturing Chemists' Association, 1825 Connecticut Avenue, N.W., Washington 9, D. C. A 64-page illustrated booklet covering the use of agricultural chemicals in public health and wildlife preservation, as well as agriculture, giving rules for their safe handling, treating biological control of pests, and providing a glossary and list of selected references. 25 cents.

BOOKS

Garden Design

A History of Garden Design. Derek Clifford. 232 pages, 78 halftones. Frederick A. Praeger, New York. \$13.75.

The evolution of the garden as a work of art is described, beginning with the Renaissance, continuing through Spanish and French gardens of the 16th and 17th centuries, covering the "great revolution of taste" which brought greater naturalness into gardens, and concluding with the gardens of today—that is of the past 80 years. Oriental and American gardens are included.

Ladies' Home Journal Book of Landscaping and Outdoor Living. Richard Pratt. 225 pages (8 by 10 inches), 100 photographs, 32 pages in full color. M. Evans and Company, New York, and J. B. Lippincott Company, Philadelphia. \$7.95.

"Homescaping" is the author's term for landscape planning which surrounds the house. Design, ease of maintenance, and convenient, pleasurable living in the open are emphasized.

Sunset Garden Plans. Prepared by the editors of *Sunset* books and *Sunset* magazine. 80 pages (8½ by 11 inches), paper bound. Lane Book Company, Menlo Park, California. \$1.75.

Plans of 49 existing properties, most of them on the West Coast, are printed in green and black, then illustrated with photographs of the finished landscape.

Imaginative Small Gardens. Nancy Grasby. 256 pages, illustrated. Hearthside Press, New York. \$4.95.

A book for beginners, with garden plans, construction diagrams, photographs and descriptive plant lists expertly presented by a landscape architect.

The Joy of a Small Garden. Janet Gillespie. 216 pages, drawings and plans. Dodd, Mead, New York. \$3.95.

An informal, highly personal account of how one family achieved the garden beauty they sought with little outlay of money. Fruit trees, bulbs, roses, perennials, herbs, ferns and a wild garden have been some of their achievements at different periods.

How to Landscape Your Own Home. J. I. Rodale and staff, supervised by Dorothy Patton Franz. 1,544 pages, 475 photographs, 75 drawings, 30 tables. Rodale

Books, Inc., Emmaus, Pennsylvania. \$9.95.

Between "Selection of a Home Site" (Chapter 1, in the opening section on Landscaping) and "House Plants" (the concluding subject), practical aspects of gardening by the organic method are presented under the headings of Garden Operations, Lawns, Trees, Shrubs and Vines, Herbaceous Ornamentals and Ornamentals Indoors. Thirty tables, chiefly giving characteristics and needs of cultivated plants, occupy 300 pages. The glossary contains about 1700 plant names.

Garden Practice

Kalendarium Hortense, or The Gard'ner's Almanac. John Evelyn. 224 pages. Facsimile reproduction of the tenth edition (1706). 485 numbered copies on rag paper, hand bound. The Herb Grower Press, Falls Village, Connecticut. \$10.

A renowned work of historic significance in horticulture; the first to use the words "green-house" and "conservatory" (see "Greenhouse Story in England" by E. A. Smith, *Plants & Gardens*, Summer 1963). John Evelyn gives month-by-month advice for the care of the garden.

The City Gardener. Philip Truex. 355 pages, drawings and photographs. Alfred A. Knopf, Inc., New York. \$6.95.

Roof gardening and back-yard gardening under conditions such as New York City presents, with ideas for plant selection and planting design by a man who has created many New York gardens. Includes an almanac for garden care.

The American Home Garden Book and Plant Encyclopedia. Editors and Staff of *The American Home*. 512 pages, many photographs and drawings; 16 pages in full color. M. Evans and Company, New York, and J. B. Lippincott, Philadelphia. \$7.95.

Chapters deal with garden flowers and gardens of all kinds, including hobby flowers and eight special "conversation" gardens; also woody plants, plants indoors and under artificial light, landscaping and its appurtenances, and such aspects of plant cultivation as soils, fertilizers, propagation, pruning, and control of weeds, diseases and pests. The plant encyclopedia included contains descriptions and culture of more than 2,500 plants for every climate of the U.S.A.

Sunset Basic Gardening Illustrated. 125 pages (8½ by 11 inches), 925 photographs and drawings, paper bound. Lane Book Company, Menlo Park, California. \$1.95.

A "visual handbook" for every aspect of garden planting and maintenance.

You Can Garden in Florida. Mary Noble. 148 pages, drawings and photographs. Published by the author, 3003 Riverside Avenue, Jacksonville, Florida, 32205. \$1.98.

Plants and procedures for gardening in each of Florida's three zones (north and west, central, and south) are lucidly presented. Special attention is given to problems the newcomer may encounter.

Garden Plants

All About Miniature Plants and Gardens, Indoors and Out. Bernice Brilmayer. 319 pages, photographs (color and halftone), sketches and landscape plans. Doubleday and Company, Garden City, New York. \$4.95.

Every conceivable aspect of the subject seems to have been touched upon, with descriptive plant lists provided in abundance for both indoor and outdoor cultivation of small-stature plants.

Flowering Trees. Robert B. Clark. 241 pages, 28 drawings and 6 color plates by Darrell Sweet. D. Van Nostrand Company, Princeton, New Jersey. \$6.50.

Informal treatment of cherries, crab apples, dogwood, magnolia and other groups, plus 40 more individual kinds of flowering trees for the home property, with cultural information and many useful lists.

The Concise Encyclopedia of Favorite Flowering Shrubs. Marjorie J. Dietz. 316 pages, drawings. Doubleday & Company, Garden City, New York. \$4.95.

Appearance, assets, faults (if present), culture, pruning, uses and other information given for about 100 shrubs. Drawings show each shrub's general habit and a detail, generally of a flowering branch.

Effective Flowering Shrubs, revised edition. color plates. St. Martin's Press, New York. \$6.50.

Selection, description and culture of shrubs suitable for English gardens; of limited value in the United States because of differences in climate and, often, in the varieties offered by nurseries.

Shrubs and Trees for the Home Landscape. James Bush-Brown. 210 pages, photo-

graphs. Chilton Books, Philadelphia. \$5.95.

Fifty introductory pages are followed by alphabetical treatment of about 300 kinds of useful woody plants. Descriptive notes, cultural information, hardiness and uses are given, with extensive lists at the end.

The Wonderful World of Bulbs. Bebe Miles. 348 pages, color plates, photographs and drawings. D. Van Nostrand Company, Princeton, New Jersey. \$7.50.

Flowers that grow from bulbs, corms, tubers and rhizomes are treated: both tender and hardy kinds for outdoor culture and plants for indoor use as well.

Handbook of Wild Flower Cultivation. Kathryn E. Taylor and Stephen F. Hamblin. 307 pages, 140 drawings of flowers by Catherine R. Hammond. The Macmillan Company, New York. \$5.95.

How to obtain desirable plants from the wild without risk of loss, how to grow and propagate each of many kinds, which ones to avoid (because of their rarity, difficulty or invasive properties)—these features all reflect the experience of both authors. Lists divide plants by their cultural requirements and give sources of plants, seeds and supplies.

The Oxford Book of Garden Flowers. B. E. Nicholson, M. Wallis, E. B. Anderson, A. P. Balfour, M. Fish, and V. Finnis. 207 pages, 96 colored plates illustrating some 500 flowers. Oxford University Press, London. 25 shillings.

An interesting arrangement of garden plants, all by season, starting with the new year when numerous shrubs and herbaceous plants can be seen in flower in England.

Garden Flowers. R. D. Meikle. 479 pages, 15 color plates, numerous drawings. The Kew Series, Eyre & Spottiswoode, London. 1/10/-.

About 800 members of more than 70 plant families described. Many interesting-appearing species are unknown in American gardens.

A Picture Dictionary for the Home Gardener. Andrée Vilas Grabe. 168 pages, photographs. Hill and Wang, New York. \$4.95.

Alphabetical entries for 887 plants appear under such headings as perennials, biennials, annuals, rock garden plants, trees, shrubs, hedges, ground covers and vines. Brief descriptions and cultural needs are given.

The Moutan or Tree Peony. Michael Hawthorth-Booth. 106 pages, photographs. St. Martin's Press, New York. \$3.95.

A small book containing, besides cultural notes, a long list of varietal names with brief descriptions.

The New Complete Book of African Violets. Helen Van Pelt Wilson. 299 pages, 8 color plates, 36 photographs, 38 drawings. M. Barrows and Co., New York. \$5.95.

The latest word from an enthusiastic grower and writer whose name has been associated with African violets since the early days of their popularity. Includes growing under fluorescent lights.

House Plants

The World Book of House Plants. Elvin McDonald. 318 pages, 50 photographs, about 200 line drawings, 12 tables and charts. World Publishing Company, Cleveland and New York. \$7.95.

A comprehensive guide for all who wish to grow plants indoors, whatever their situation. Lists show the preferences of plants for certain amounts of light and heat; charts make it easy to diagnose and remedy plant troubles. An illustrated encyclopedia of 700 indoor plants is included.

Growing Orchids at your Windows. Jack Kramer. 151 pages, illustrated. D. Van Nostrand Company, Princeton, New Jersey. \$4.95.

Cultural directions for 200 kinds, about half of which the author has grown and flowered in a city apartment. Drawings of more than 40 kinds and photographs of several others.

1001 House Plant Questions Answered. Stanley Sehuler. 278 pages, 21 drawings. D. Van Nostrand Company, Princeton, New Jersey. \$5.95.

General culture, specific plants (in alphabetical order) and lists of plants for different situations are included in the answers to the 1001 questions.

Flower Arrangement

Nature, Art and Flower Arrangement. Emma Hodgkinson Cyphers. 160 pages, 72 illustrations. Hearthside Press, New York. \$4.95.

"Nature is not art," the author emphasizes, but the principles of nature are used in the creation of art forms. Nature's patterns, movements, lines and solids are shown diagrammatically as a guide to their interpretation in flower arrangements.

Miniature Flower Arrangements and Plantings. Lois Wilson. 181 pages, 12 color photographs, 62 halftones. D. Van Nostrand Company, Princeton, New Jersey. \$6.50.

Lists of suitably small plants and where to find them conclude this guide to the diminutive, which describes, besides the making of minute arrangements, the usefulness of miniature plants in teaching and therapy work.

An Easy Guide to Japanese Flower Arrangement Styles. Lida Webb. 159 pages, 24 photographs, 107 drawings. Hearthside Press, New York. \$3.95.

Tenets of six schools explained, with a dictionary of terms used.

Japanese Flower Arrangement—A Complete Primer. Ellen G. Allen. 86 pages, profusely illustrated. Charles E. Tuttle Company, Rutland, Vermont. \$2.75.

Fourteen lessons depict different forms of the Miribana, Heika and Seika styles.

Junior Guidance

Junior Garden-Club Handbook—A Leader's Guide. Fannie H. Peeples. 208 pages, drawings. D. Van Nostrand Company, Princeton, New Jersey. \$5.95.

How to organize a junior garden club explained and how to carry out projects in horticulture, nature study, conservation, flower arrangement and flower shows.

Junior Flower Shows. Katherine N. Cutler. 145 pages. M. Barrows & Company, New York. \$3.50.

Full details of planning procedures followed by the staging and judging of competitive exhibitions for young gardeners.

Plant Identification

The Shrub Identification Book. George W. D. Symonds. 379 pages (8½ by 11 inches); more than 3,500 photographs by A. W. Merwin. M. Barrows and Company, New York. \$15.

Pictorial keys lead to groups of shrubs on "master pages." Here, for each species treated, there are photographs of leaves, flowers, buds, twigs, branches and other distinctive and characteristic parts, with variations shown when they may be significant.

The New Field Book of American Wild Flowers. Harold William Rickett. 414 pages, drawings of 700 species and color photographs of 96 others by the author. G. P. Putnam's Sons, New York. \$4.95.

A guide by which nearly 1,000 wild her-

baccous plants of the northeastern and north central states can be readily identified. Technical terms are kept to a minimum.

Manual of Vascular Plants. H. A. Gleason and Arthur Cronquist. 810 pages, no illustrations. D. Van Nostrand Company, Princeton, New Jersey. \$11.75.

An abridgement of the three-volume work by H. A. Gleason, "The New Britton & Brown Illustrated Flora of Eastern United States and Adjacent Canada."

A Field Guide to Rocky Mountain Wildflowers. John J. Craighead, Frank C. Craighead, Jr., and Ray J. Davis. 209 species illustrated in color, 118 drawings. Houghton Mifflin Company, Boston. \$4.95.

A new volume in the Peterson Field Guide Series, covering nearly 600 species—those the traveler is most likely to see between southern British Columbia and northern Arizona and New Mexico.

California Mountain Wildflowers. Philip A. Munz. 122 pages, 96 color photographs, 180 drawings, 2 maps, paperbound. University of California Press, Berkeley and Los Angeles. \$2.95.

A simple guide arranged largely by color for the identification of nearly 300 flowers and a few ferns that are common in the mountains of California.

A Dictionary of Trees. Fred Walden. 80 pages (8½ by 11 inches), paper bound. Great Outdoors Publishing Company, 4747 28th Street, North, St. Petersburg, Florida. \$1.

About 150 trees that grow in Florida described and illustrated, each with a sketch of the tree and of significant details.

The Mushroom Hunter's Field Guide, revised and enlarged. Alexander H. Smith. University of Michigan Press, Ann Arbor. \$6.95.

A tall, lean book containing descriptions and photographic illustrations, in black and white and in color, of 188 species of fleshy fungi.

Of Plants and Their Names and Uses

Look at a Flower. Anne Ophelia T. Dowden. 120 pages, profusely illustrated. Thomas Y. Crowell Company, New York. \$4.50.

This observant artist's delicate drawings, each in black and white with one color, provide a pleasant introduction to the ways of flowering plants. Some of Mrs. Dowden's work (under the name of Anne Ophelia

Todd) has been exhibited at the Brooklyn Botanic Garden.

1001 Questions Answered About Flowers. Norman Taylor. 335 pages, 16 photographs, numerous drawings. Dodd, Mead and Company, New York. \$6.

Form and function of flowers, orchids, eastern and western wildflowers, cultivated flowers of olden times and of today, flowers from trees and shrubs and tropical flowers are the principal headings under which 1001 questions are asked. A thorough index is an aid in finding information of interest.

A Gardener's Book of Plant Names. A. W. Smith. 428 pages. Harper and Row, New York. \$5.95.

Pronunciation, meanings and origins of more than 4,000 generic and specific names of cultivated plants, with a list of common names and corresponding botanical names.

How Plants Get Their Names. L. H. Bailey, 181 pages, paper bound. Dover Publications, New York. \$1.15.

Reprint of a work first published in 1933, once considered a classic but now in parts outdated.

Using Plants for Healing. Nelson Coon. 272 pages, drawings. Hearthsides Press, New York. \$4.95.

Subtitled "An American Herbal," this book is based on sound knowledge of the plants described and of their uses. Following a historic background, the author, begging a balanced viewpoint from his readers, tells how and when to seek plants for home remedies, and how to prepare and use them.

Special Interests

Bonsai-Saikei. The Japanese Miniature Trees, Gardens, and Landscapes. Toshio Kawamoto and Joseph Y. Kurihara. 362 pages, illustrated. Nippon Saikei Co., Tokyo, Japan. \$18.00.

This splendid book, first priced at \$30.00, is now available at \$18.00. Hundreds of line drawings (including step-by-step drawings showing techniques), halftones and full page color plates. A complete guide for bonsai enthusiasts.

Outstanding chapters on potting, repotting, moss and soil; nipping, pruning and shaping; position and direction of trees and rocks; rock and group planting; miniature gardens and landscapes. The author is happy that "one of the national arts of Japan is rapidly becoming an International Art of the World."

Carolina Gardens. E. T. H. Shaffer. 326 pages, 40 photographs. Third edition. Devin-Adair Co., New York. \$6.95.

Family histories are intertwined with the stories and descriptions of the great plantations and other estates of the Carolinas. Included are famous colonial places and gardens of the coast, the pinelands and sandhills, the piedmont and the mountains.

John Clayton, Pioneer of American Botany. Edmund Berkeley and Dorothy Smith Berkeley. 236 pages. University of North Carolina Press, Chapel Hill. \$6.

Exploration, discoveries, correspondence and an evaluation of one of America's early botanists (1696-1773).

Scientists Who Work Outdoors. Lynn and Gray Poole. 178 pages. Dodd, Mead and Company, New York. \$3.50.

Among the characters in this "Makers of our Modern World" book are Harry A. Borthwick of the U.S. Department of Agriculture, David Burpee, horticulturist, and Edwin Way Teale, naturalist and writer.

Learning and Living

Horticultural Science. Jules Janick. 472 pages, photographs and drawings. W. H. Freeman & Company, San Francisco. \$8.50.

A college textbook which could prove informative to amateurs seeking background knowledge about gardening.

A Place to Live. The Yearbook of Agricul-

ture 1963. The United States Department of Agriculture. 584 pages, illustrated with line drawings. Alfred Stefferud, editor. For sale by the Superintendent of Documents, Washington, D. C., 20402. \$3.

Under nine headings, starting with "Changes of People" (why they move and what adjustments need to be made by and for them), an attempt is made to interpret the city to the country and the country to the city; also to point the way for healthy, attractive, satisfactory, and economically sound communities for people of today and tomorrow. Subsequent topics include Land, Water and Air, Farming, Communities (different types and ways of improving them), and What to Do. Among the examples which conclude the book are articles on planning and zoning in Alaska and Hawaii, British experience, Japan's parklike aspect (by John M. Creech), planting for beautification, and the role of educational garden centers and garden clubs.

Careers in Conservation. Edited by Henry Clepper. 112 pages. Ronald Press, New York. \$3.75.

Nine specialists in natural resources tell of opportunities for life work in soil conservation, wildlife management, fisheries, forestry, range and watershed management, parks and recreational development and natural resources administration; also of the education necessary to achieve positions in these fields.



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